POWER

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FRED R. LOW, *Editor*

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Propaganda

WHAT do you think of so-and-so? Why do you think as you do about it? Have you sought the real facts and reasoned out your own conclusions or are you simply reacting, unconsciously, perhaps, to the missionary work of those whose interests are involved?

What or who motivates these purveyors of approbation or palliation for certain acts or policies and of criticism or condemnation for others? Who pays for the formulation of the ready-to-use opinions with which the press and pulpit, schools and lecture platforms, radio programs, society proceedings, legislative halls and every avenue of approach to public opinion are deluged?

Not all propaganda is bunk, but a lot of it would be accorded an altogether different reception if those to whom it is addressed knew just how it is concocted and why.

The pronouncement of some eminent authority upon the wisdom or iniquity of a proposed proceeding might be less convincing and invite real consideration and analysis before acceptance if it were known that he was the paid propagandist for an interested group or industry.

I wonder how much it costs in the aggregate to keep all of these selfishly activated instrumentalities for the moulding of public opinion going.

And how little we realize that the victims of the propaganda pay its cost. It has not only to be charged into the expenses of the perpetrators and thus into the price of their products, but, if it is successful, the public has to make good the advantage for which they have schemed.

It hurts some people to think and they must have somewhere to go for their opinions. And some would rather have their opinions pleasing to their patrons and entourage than to be right but considered odd and unamenable.

It is not surprising that effort for privilege, advantage or control in a social and political system that is particularly supposed to be dominated by public opinion should sometimes depart from the ethical. A few more exposures of flagrant instances may lead to the undoing of the process by its own brashness.

F. R. Low

POWER *Stands for . . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application

Total Cost Is What Counts

SALESMEN, engineers and business men often fall into an easy-going, but misleading, method of comparing the savings obtainable from new equipment installations.

All too frequently, when one hears that such and such an installation will pay for itself in so many years, it is found on investigation that interest, taxes and insurance have been totally neglected in arriving at the conclusion—that the years to pay out are taken simply as the first cost divided by the yearly saving in operating cost. Obviously, this is misleading, for interest has been paid on borrowed money during the "pay-out" period, or (which is fundamentally the same thing) money has been made unavailable for other interest-earning investment. The reality of this expense cannot be denied, nor can the buyer, without self-delusion, overlook the items of taxes and insurance.

Depreciation can, it is true, be omitted in a statement of this sort if the buyer is willing to admit that at the end of the "pay-out" period he will possess, not the original article but one of somewhat lower value.

This has particular point just now because *Power* recently fell into the same pit. In a paper presented a few days ago before the Engineers Society of Western Pennsylvania, F. M. Van Deventer expertly exposed this and kindred "economic fallacies in isolated-plant cost analyses." As an example of how not to figure, Mr. Van Deventer selected a recent article in *Power* where a headline proclaimed savings that paid the cost in five years. Actually, as was apparent from the data given in the article, the yearly saving in *operating cost* was one-fifth of the first cost. This, as Mr. Van Deventer correctly pointed out, is a horse of another color. Neither the difficulty of attaining precision in headlines and other condensed expressions, nor the fact that the actual situation was made clear to the careful reader, quite excuses this lapse into statements of the sort that *Power* is particularly anxious to discourage in the field of cost analysis.

The foregoing criticism of paying out cost by operating savings alone does not apply to cases where financing is carried by a manufacturer or finance company that takes its pay out of the savings. Here the customer does not put up any money except what he saves out of operating cost, the interest is covered in the charges, and the plant is actually paid for by these savings within the specified time. There may be cheaper ways of accomplishing the result, but this method is sometimes the more convenient, all factors considered.

The Basic Education of the Engineer

ONE thing that impresses anyone who examines European engineering textbooks is the evident assumption that those using such works will be well-grounded in the basic subjects of physics, chemistry and mathematics. No concession is made to a lack of such knowledge. There is no attempt made to write down to the level of those who are ill-grounded in the fundamentals.

How different things are on this side of the [illegible]. The writer of an American engineering book generally begins with words of one syllable, so to speak, and gradually leads his reader into the subject, meanwhile avoiding the scientific and theoretical side as much as possible.

Unfortunately, this contrast is too well-justified by the educational equipment of American engineers. It is but seldom that an engineer is encountered who, several years out of school, has even a fair working knowledge of physics or mathematics.

Whether this condition results from the educational system, from an inborn lack of aptitude for the sciences or from some other cause, is hard to say. But, whatever the reason, it is to be hoped that educators will give the matter such close scrutiny as to arrive at the cause and apply such corrective measures as may be possible.

A "Dud"

LAST week at the Third National Fuels Meeting in Philadelphia a whole session was provided for the discussion of stokers. The stage was set for what promised to be a most profitable session. About two hundred were present, including manufacturers of both stokers and pulverized-coal equipment, their engineers, well-known operators and consulting engineers. Some had come from as far as Chicago and Milwaukee to attend this session.

The paper was in the form of a symposium prepared by four well-known stoker engineers and read by the president of the Stoker Manufacturers' Association. It had been prepared with the idea merely of providing a background for the expected discussion. But the "expected" did not happen. In spite of the chairman's efforts, there was no discussion.

The time is probably past when, at the drop of the handkerchief, a free-for-all argument can be started between the advocates of stokers and those of pulverized

coal. The subject has been talked out, and it is just as well.

In arranging the program it was not with the thought of reviewing such controversies that stokers were made a part of it. Rather it was in acknowledgment of the important part that stokers play in power generation, the progress made in their development, and the many operating problems introduced by the demands of present practice, that prompted their inclusion.

A vast amount of stoker experience was represented by those present at the session. Did each one attend with the thought that he might gain something from the other fellow without offering anything in return, or was there a fear that frank discussion of the stoker problems might open the way to attack from the pulverized-coal adherents? Perhaps there was a tacit agreement among some to avoid such discussion. Whatever the cause, the session proved a "dud."

The Fuels Meeting as a whole was a big success. Some sessions and some papers about which there had been misgivings in advance went over strong. Others, of which much had been expected, did not do so well. One can never tell.

Improving the Reliability of Hydro-Electric Units

HYDRO-ELECTRIC generating units are generally considered as possessing a high degree of reliability. They have records of continuous operation of thirty months without being taken off the system. On the other hand, all the buckets have, for no apparent reason, broken out of a runner and gone down the draft tube. Therefore, waterwheel units have no monopoly on the much-cherished factor of reliability.

A recent report of the National Electric Light Associations Hydraulic Power Committee shows some interesting facts on the reliability of waterwheel generating units and the causes of outage. In 1927 the 134 units investigated had an outage time, when the units were required for service, of only 1.23 per cent. The actual average outage was about three times this figure.

An analysis of the causes of these outages shows that the greatest single source of trouble is the runner. It might be expected that general hydraulic causes, such as ice, trash, floods, waterways and gates, since their conditions are frequently difficult to control, would be responsible for a large percentage of the outage time, but these account for only a little over eleven per cent. Over sixty-five per cent of this time is chargeable to one unit that was put out of service by floods and ice.

The generators, including their auxiliaries, are responsible for less than twenty per cent of the outage time. More than one-third of this is represented in inspection and cleaning. Nearly seventy per cent of the time the units were out of service is chargeable to the waterwheels and their auxiliaries. The largest single item in this part of the total outage time is caused by the runner, which accounts for over seventeen per cent of the total time from all causes. The draft tube, bearings and lubricating system are responsible for about seventeen per cent more of the total outage time. Inspection and overhauling also required over seventeen per cent of the total time the units were out of service.

This report indicates that if the reliability of hydro-electric units is to be increased, the waterwheel offers the greatest opportunity for improvement. Some waterwheels have operated for years without giving any trouble whatsoever. Others have given trouble almost from the instant of starting. These troubles have developed from a variety of causes, such as vibration, buckets breaking from the runner, draft-tube difficulties and others. If the waterwheel is to be consistently the highly reliable and dependable unit it is capable of being, such faults must be prevented—by proper design—from developing during operation.

Partners Toward Peace

IN THE great international development of the past week, the personal meeting of President Hoover and Prime Minister MacDonald, it would certainly be possible to find some point of matter-of-fact significance to us who are concerned with power generation and utilization. It would certainly be possible to single out this little point, elaborate upon it, and say, "The conferences between Hoover and MacDonald mean thus and so to men in power's field." It would be possible to do this and let it go at that.

But in this meeting of these men and of their minds—this symbol of the growing consciousness of the interrelation and interdependence, political, social and economic, of two great nations—is something too big to be tied to a single application. It would be as well to eulogize the pigment on a square inch of the canvas of a masterpiece, and ignore the whole.

Like the statesmen themselves, we must look upon such personal expression of the growing kinship between two nations and their industries, not as a specific cure for this or that, but as the inauguration of an era of good feeling that will prevent the ills for which specific cures are necessary.

Moreover, international industry must always be in inverse ratio to international enmity, and international enmity is more deeply buried with every personal word that passes between two statesmen. With the ever-increasing growth of international corporations and foreign branches, industry has already overstepped national boundaries. Wars between nations must now be regarded as insurrections within a single economic and industrial entity that knows no political frontiers. Just as political democracy has made insurrections futile and unnecessary, so international understanding must do the same for war. Just as freedom from insurrection speeds national industry, so freedom from war, and the chance of war, will speed international industry.

And, incidentally, if we must be matter of fact, when that comes about, somebody is going to need more power.

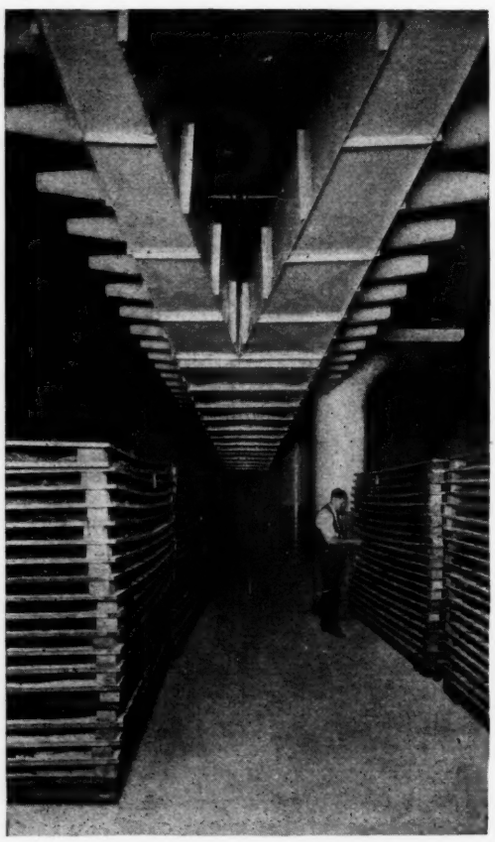
Modern Cigar Making *Demands* *Up-to-Date* Power Services

CONVERSION OF CIGAR MAKING *from the age-old hand process to mechanical means has been dependent largely on the aid furnished by the power engineer. Because of the delicate characteristics inherent in all tobaccos, the highly developed cigar-making machine would be of little use, and large-scale handling of tobacco unprofitable, without air conditioning, refrigeration, process steam and compressed air.*

By RUSH D. TOUTON
Technical Director
Bayuk Cigars, Inc.

AN OUTSTANDING example of the application of modern power services in cigar manufacture is the main plant of Bayuk Cigars, Inc., Philadelphia, Pa., where 4,000,000 "Bayuk Philadelphia" cigars are produced weekly. The building measures 320 ft. in length, with a width of 70 ft. at the front and approximately 100 ft. at the rear. There are eight manufacturing floors covering this area, with a basement and two additional smaller floors, where the power service equipment is installed.

Air-conditioned throughout, the building is insulated with two inches of cork board in walls and the roof. This insulation while rather unusual is more than compensated for in the advantages gained from reduced heat loss in winter and the corresponding reduction in the amount of refrigeration required for cooling in summer. Double steel sashes are used in all window openings, and a steam line between the two sashes to prevent condensation on the inner sash. This is necessary because of the high dew point of the air-conditioning process. With the insulated walls and the double-heated sash, the condensation which is so frequent in highly humidified buildings is totally absent, and accurate control of the atmospheric condition is made possible.



Ducts supplying 55,000 c.f.m. of conditioned air to a drying room

The air-conditioning system consists of two main humidifiers, ten separate ejector systems for special purposes, and four unit humidifiers. Each of the two central systems has a 50-hp. motor on its fan and delivers approximately 55,000 c.f.m. of air. One humidifier, located in the basement, feeds upward through a brick supply duct to the first, second, third and fourth floors. The other, on the ninth floor, furnishes air downward through a similar duct to the eighth, seventh, sixth and fifth floors. On each of these floors the distributing ducts are arranged with the unit heaters immediately outside the main supply shaft. These unit heaters are controlled by diaphragm valves operated from various points on the floors. Adjacent to the main supply shaft is the return shaft, through which the air is permitted to return to the humidifiers or to be exhausted to the outside as weather conditions may demand.

In the winter time the conventional practice of furnishing steam to the spray water in the humidifiers is followed for increasing the dew point temperature; in the summer the cooled water from the centrifugal refrigeration machine keeps the dew point down to the desired temperature.

The main refrigeration machine, in the basement, is of the centrifugal type and has a capacity of 100 tons in 24 hr. The refrigerant is dielene, and the unit operates under a vacuum. The 150-hp. motor, operating at 3,400 r.p.m., is directly connected to the compressor. Condenser water is obtained from a spray pond, located on the tenth floor of the building. This water is pumped to the higher level by a 30-hp. centrifugal pump, which handles 500 g.p.m. through four-inch lines. The cooled water coming from the evaporator is taken through four-inch cork-insulated lines to the humidifier, on the ninth floor. A heat exchanger in the discharge line furnishes cold water to the basement humidifier. This permits

the use of one cold-water pump for the work on the two different levels.

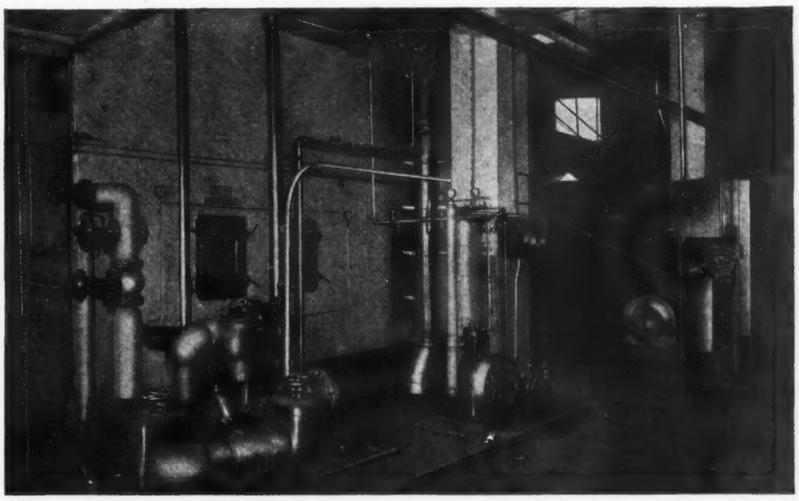
In the same basement are three ammonia refrigeration machines, each of the two-cylinder vertical type and of approximately five tons capacity. One is used for cooling the circulating ice water in the building. Another, with a similar cooling tank, is used for chilling water to 45 deg. This water is pumped to the second floor at the rate of 20 g.p.m. as the cooling medium for the new-type unit humidifiers, which maintain low temperatures for special types of tobacco. The last machine is connected to a brine cooler and holds the brine at 15 to 18 deg. F. This brine is circulated to the third floor for cooling the three refrigerators in the cafeteria. A certain amount of the same brine is used to condition the air in the retail office, on the first floor.

Steam for process and heating is furnished by three boilers, in the sub-basement. Two of these, having 1,000 sq.ft. of heating surface, are used during the winter for the entire load. The third has approximately 585 sq.ft. of heating surface and carries the process load during the summer. Bunker oil of 14-16 deg. Baumé is used for firing.

From the steam header a ten-inch main runs up through a pipe shaft in the center of the building to supply direct radiation in the stairways, halls and various small rooms in the building. The main manufacturing floors are completely heated by unit heaters placed in the air ducts, under automatic control. All steam for these unit heaters and for process work is taken from a twelve-inch supply riser located in the same pipe shaft. The unusual feature of this steam piping, which is of the two-pipe open-vent gravity-return type, is that free and noiseless circulation is obtained at less than two pounds gage pressure.

The possibilities of manufactured and purchased power were considered at the time the plant was erected and because of the favorable rate to be obtained by the use of 2,300-volt service it was decided to buy the electrical current needed. In a vault in the basement are four 200-kw. transformers, which change the voltage to 220 for use on the power load. The lighting current is obtained at 110 volts through two 200-kw. transformers, and two additional 75-kw. transformers supply 220-volt current direct to the large refrigeration machine.

The maximum demand in the plant is approximately 600 kw. There are over 900 separate motors in the building, ranging from a 1/20 hp. to 150 hp. per unit.



Automatically controlled, this air washer meets the exacting conditions of cigar making

After the plant had been in operation for some time it was found that a penalty was being paid because of an existing power factor of 70 per cent. To correct this condition 150-kva. static condensers were installed, the resulting power factor being 96 per cent, which is well above the penalty limit.

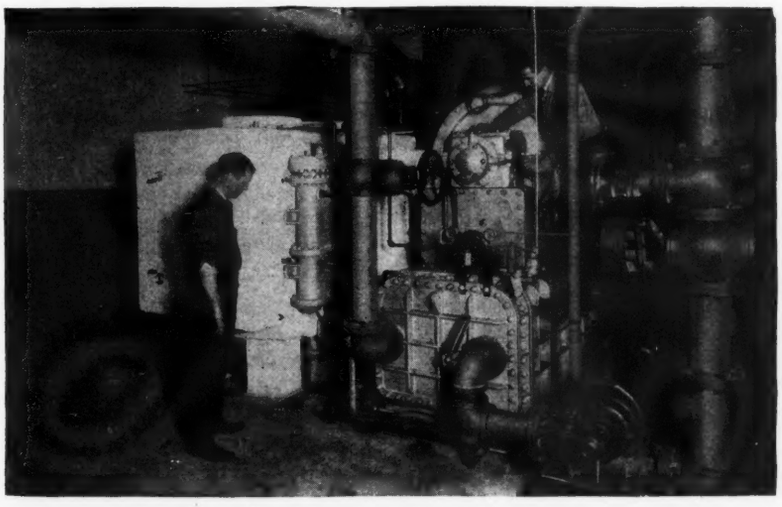
Separate lines bringing in auxiliary service at 110 and 220 volts are connected through an automatic relay to the essential stairway, basement, boiler room and exit lights and to the oil burner and pump motors. While the main power is interrupted rarely, this auxiliary service has been found to be a great convenience in keeping the building in order.

Within the last year approximately 40 kw. of new "Daylight" lighting units have been installed at all points in the building where the product is selected for color.

Many drying rooms are provided to remove the excess moisture from the tobacco. Moisture is added to make the tobacco sufficiently pliable to prevent breakage while on the stripping floor. The ejector system of drying, with close automatic control, is used for this purpose. The results have been very satisfactory.

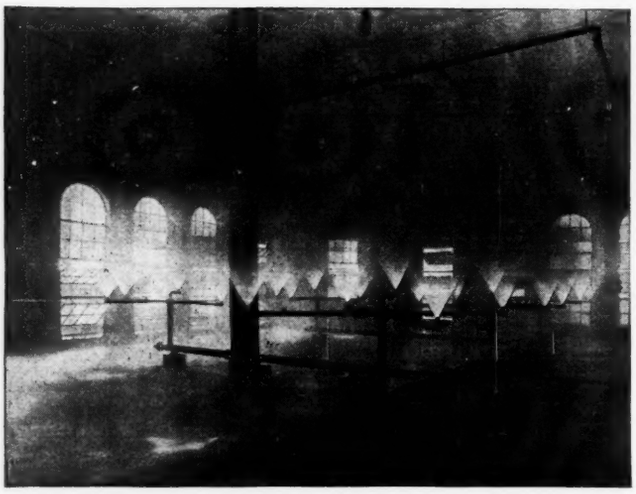
Each cigar machine, of which there are 200, is operated by a ½-hp. motor and a 1/20-hp. direct-connected motor. It is necessary to provide for each machine a suction of eight inches of water through a five-inch connection, necessitating the removal of 200 cu.ft. of air per minute from the machine. This is accomplished by large suction fans on the ninth floor. Each group of 100 cigar machines has

Central refrigeration machine with a capacity of 100 tons in 24 hours



a 50-hp. motor, with direct connected steel plate fan, and a 30-hp. motor, also with direct connected fan, for breakdown service. The air thus removed is taken through dust arresters, which separate out the solid matter and allow the cleaned air to return to the intake of the humidifier.

The transportation of all raw and finished materials in the building is handled, in so far as possible, by a complete conveyor system. On the conveyor drives there are approximately 100 motors, ranging from the fractional horsepower sizes up to 5 hp. Because of the low speeds of the conveyors, the motors are all connected through reducing gears to their individual loads. The system is automatic as far as possible, and a great deal of control equipment is necessary. Some interesting



An unusual installation, this spray pond is located in a pent house on the roof of the factory

arrangements have been made, particularly on the reciprocating lifts, which reverse their operation more than once a minute during the whole day.

A small amount of compressed air at 50 lb. pressure must be furnished each cigar machine. This is provided through reducing valves from the main supply, obtained at 100 lb. pressure from two horizontal compressors of 90 cu.ft. capacity each. Each one of these compressors is direct connected to a 35-hp. synchronous motor. Before being used at the cigar machines the air is passed through three cooling tanks, since it is imperative that it then be free from moisture. Small additional compressors furnish the air required during the night hours for the pneumatic controls on the air-conditioning system and maintain the required pressure on the sprinkler tanks.

Because of the high humidity carried, all materials used in the construction and equipment are the very best. Exhaust ducts from the fermentation and drying rooms are of copper, for ordinary galvanized iron would not withstand the action of tobacco fumes. Also because of the high moisture content of the air the usual insulation on water lines is not satisfactory and ice-water-thickness cork was applied to all these lines.

Soundness of design means utility and perfection. This central Bayuk plant is a splendid example of such achievement. With its modern power services, it stands out as a work which proves to the industry that cigar manufacturing responds efficiently to the technical practices of the power engineer.

The TICKLER

As a Daily Reminder

By Walter N. Polakov*
Consulting Engineer, New York City

SMALL concerns have few problems for their executives to remember. But in larger organizations reliance on memory is the shortest way to failure. This article, describing the use of "ticklers," suggests a system that regularly directs attention to the jobs to be done.

Purpose: The purpose of a tickler is to remind the busy chief engineer and those co-operating with him: About jobs to be attended to, and about jobs completed.

Form: A special printed form, or even scraps of paper, may be used. If bits of paper are used, they should be stamped for identification.

Filing: The tickler file consists of 12 compartments, one for each month of the year. The current month and the next one are provided with 31-division files, the sections corresponding to each day of the month.

Use of tickler: Every time a request or promise is made to attend to a certain job, conference, inspection, etc., a tickler slip is written, stating shortly and concisely the nature of the reminder. If it is a request that somebody else has to attend to, make a carbon copy of the tickler and mail the original. If it is for personal use, no carbon copy is necessary.

Date each tickler when it has to come out for attention and write in the date when the request is expected to be complied with. Deposit every tickler in the section of the file corresponding to the date it is to come out.

Every day open the section for the day and take out all ticklers marked for the day. Keep on the desk those

TICKLER

SYMBOL

NAME_____ YOUR ATTENTION IS CALLED TO THE FOLLOWING

SEND THIS SLIP BACK TO TICKLER TO COME OUT ON A LATER DATE IF YOU HAVE NOT ATTENDED TO THE WORK

DATE TO COME OUT

YEAR MONTH DAY HOUR

19
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PLEASE REPORT TO_____ WHEN THIS HAS BEEN ATTENDED TO

SIGNED_____

A suggested form for a printed tickler

addressed to yourself. Check them O. K. when attended to. If not acted upon, redate them and file again.

Phone to parties to whom originals were sent, inquiring whether the matter was attended to and deposit the copies again, if the work is not finished, under the date the request was promised for completion. Phone to parties whose time is up, or see them, to ascertain why your request was not complied with. Then send another reminder and refile the tickler copy a few days ahead.

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How to Prepare a Schedule for

Economic Boiler Loading

In Two Parts—Part II

The extraordinary practical usefulness of this article justifies its unusual length, which makes necessary its presentation in two parts. Part I appeared in the last week's number of *Power*. The importance of correct boiler scheduling is demonstrated in this concluding instalment, where it is shown that a plant with a maximum load of 100,000 kw. may incur losses of $296 to $1,039 a day by unscientific loading.

By Herbert B. Reynolds*

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A LOADING schedule was prepared in Part I of this article [see the preceding issue of *Power*], and it will be of interest to know just what the financial gain is when such a schedule is followed.

The schedule provides that for the load shown in Fig. 7 (Part I) nine boilers be fired, although eight boilers could carry the load satisfactorily, and that no boilers be banked unless the rating of the active boilers should fall below 100 per cent. Instead of following the schedule it will be assumed that only eight boilers are fired and that the rating of the active boilers will be kept at or near their maximum capacity of 300 per cent throughout the day by banking the remaining boilers. Following the process illustrated in Table II, it will be found that the operating cost per kilowatt-hour would have been $0.00458 instead of $0.00413, or an increase of 10.9 per cent. Expressed in dollars, the total daily loss would be $523, which illustrates the great gain to be realized by giving some consideration to the economic loading of boilers.

If the schedule had been followed in part by firing nine boilers but not followed by keeping the active boilers at or near 300 per cent of rating, the increase in cost would have been 13.4 per cent, or $635 per day. Thus it will be seen, in this case, that partial adherence to the schedule would result in a greater loss than if the schedule had not been followed at all. This naturally leads to the conclusion that the loss would be excessive if as many as fourteen boilers were fired when the schedule called for nine and the rating of the active boilers was kept at or near 300 per cent. Actually, the cost would be increased 21.9 per cent, resulting in a loss of $1,039 per day. On the other hand, if fourteen boilers are fired, but banked according to the schedule, the cost will be increased only 6.4 per cent, resulting in a loss of $303 per day, or $61 per excess boiler per day. If only enough boilers are fired to carry the load, eight in this case, but banked according to schedule, the excess cost will be $57 per day.

The study so far has been based on the assumption that all the active boilers are operated at the same rating. In order to determine the effect of non-uniformity of rating of the active boilers it will be assumed that the schedule is followed in so far as the number of fired and banked boilers is concerned; but of the active boilers as many as possible will be operated at 100 per cent of rating, while the remainder will be operated at as near 300 per cent rating as possible. It will be found that the cost is increased 5.7 per cent, resulting in a daily loss of $268.

Table IV gives a summary of the excess cost due to deviation from the schedule in various ways. It will be seen that excessive banking, which results in high rating of the active boilers, is the source of the greatest loss. A study of the boiler efficiency curve will divulge the reason for this. Banked boilers operate at a point of low efficiency, at the same time forcing the active boilers up to a point of high rating, where the efficiency is also low. The various cases assumed are, of course, extreme and are rarely duplicated in power stations to such a degree. However, they will serve to illustrate the need of giving careful consideration to boiler loadings.

So far this article has been devoted to the method of preparing a boiler-loading schedule for a definite type of load with a definite load factor. The remainder of the article will be devoted to a study of the effect of varying load factor, etc., upon the manner of operating the boilers and the cost of power.

By employing the curves which have already been prepared and following the method illustrated in Table

TABLE IV.—DAILY COST OF DEVIATING FROM LOADING SCHEDULE

Manner of Deviation	Operating Cost per Day	Excess Operating Cost per Day	Per Cent Increase
Schedule followed, nine fired boilers	$4,742	.....	.....
Only eight boilers fired and active boilers kept at high rating	5,265	$523	10.9
Nine boilers fired but active boilers kept at high rating	5,377	635	13.4
Fourteen boilers fired and active boilers kept at high rating	5,781	1,039	21.9
Boilers banked according to schedule but fourteen boilers fired	5,045	303	6.4
Schedule followed but active boilers operated at non-uniform rating	5,010	268	5.7
Schedule followed and with a load having the same load factor, same maximum load and same total output, but having a load curve as in Fig. 14	5,038	296	6.2

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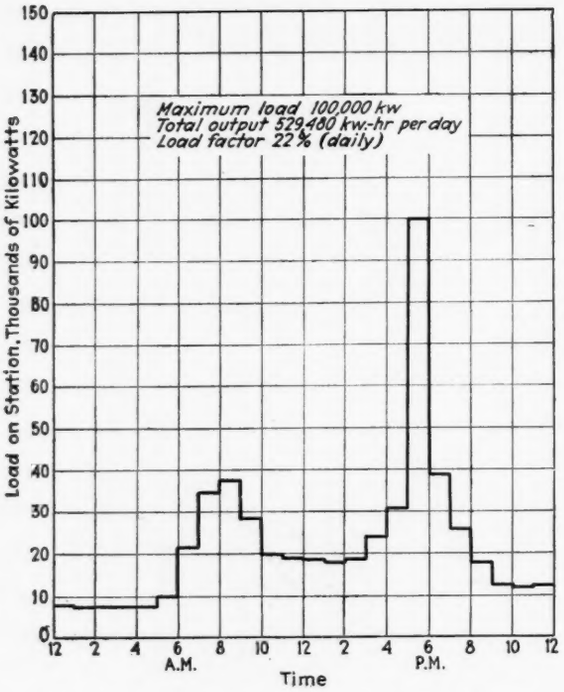


Fig. 9—Load curve having low load factor

II, the cost of power will be obtained for various load factors in addition to the one for the load curve shown in Fig. 7, which was 47.8 per cent. Fig. 9 shows a load curve the load factor of which is 22.0 per cent, while the load factor of the curve shown in Fig. 10 is 76.5 per cent. These load curves have been assumed to have the same general shape, otherwise another variable would be introduced, which would affect the cost of power. However, the effect of shape of load curve on the cost of power will be studied later.

The curves in Fig. 11 show the variation of the cost of power with the rating of the boilers during the maximum load for various load factors from 11.0 per cent to

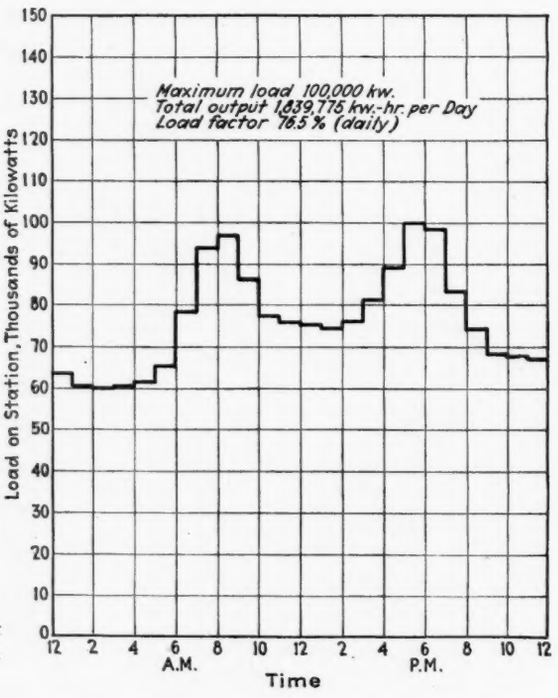


Fig. 10—Load curve having high load factor

100.0 per cent. It will be observed that the most economical loading of the boilers during the maximum loads is over 300 per cent for the low load factors, but as the load factor is increased this economic loading approaches 145 per cent at 100 per cent load factor, which coincides with the most efficient point on the boiler-characteristic curve, as seen in Figs. 1 and 3.

The curves in Fig. 11 serve to plot the curve shown in Fig. 12, which shows the relation between the load factor and the most economical rating of the boilers during the maximum load. This curve would serve as a guide to the most economical number of boilers to place in service for any load factor. In most power stations the application of a curve like this is limited. For example, although the low load factors demand a very high rating or few active boilers for maximum economy, the steaming capacity of the boilers may prevent the plant's reaching the point of maximum economy. On the other hand, the high load factors require a low rating or a large number of active boilers for maximum operating economy. However, when fixed charges are taken into account, the installation of the large number of boilers needed to keep the rating low would not be justified. In the case assumed, in which there were fourteen 20,000-sq.ft. boilers available, the limitations for the various maximum loads were shown by the dotted lines.

The curve in Fig. 13 shows how the operating cost of power generation varies with the load factor on the

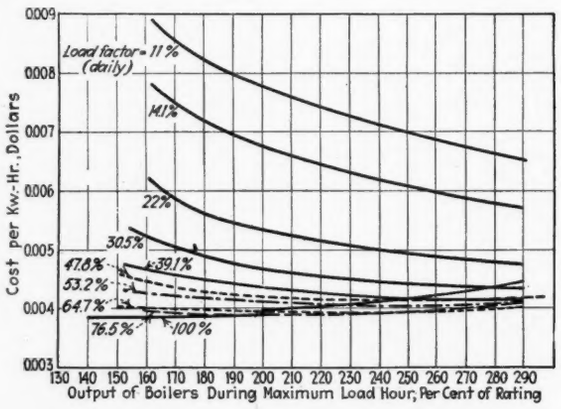


Fig. 11—Power cost with various load factors

station. For the case studied the minimum cost occurs with a load factor of approximately 60 per cent. In this study it was assumed that there were just enough boilers provided to carry the load, which is the case in most power stations where fixed charges have received proper consideration. The dotted portion of the curve shows how the operating costs would continue to decrease if a sufficient number of boilers were provided so that they could be operated at the most economic point as far as operating costs are concerned. In most cases it would not pay to provide these extra boilers, as the increased fixed charges would more than offset the saving in operating costs. However, the dotted portion of the curve can be approached whenever the maximum load on the station is less than the load for which the station was designed, due to seasonal variation, etc.

In order to study the affect of the shape of the load curve upon the operating costs, the curve shown in Fig. 14 was assumed. This load curve represents the same total output, maximum load and load factor as the curve in Fig. 7. However, the shape of the curve is radically different. It was found that the most economical boiler

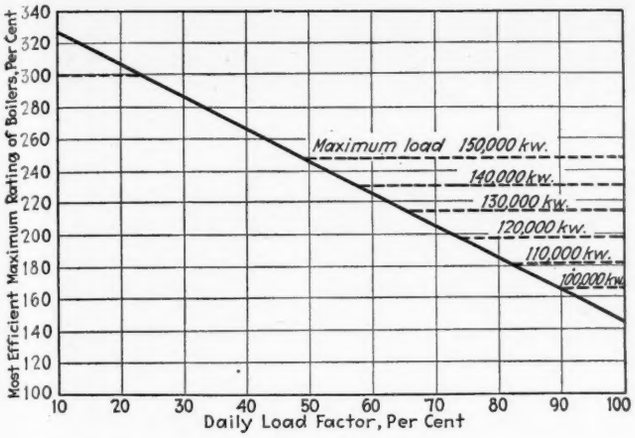


Fig. 12—Effect of load factor on economical maximum boiler rating

rating during the maximum load was 230 per cent instead of 250 per cent, as in the case of Fig. 7, requiring ten boilers to be in service instead of nine. The daily operating cost of the power was increased from $4,742 to $5,038, or an increase in 6.2 per cent. If but nine boilers were fired the cost would be increased 8 per cent over the cost of the power when produced according to the load curve shown in Fig. 7.

It should be kept in mind that this study is based on an assumed definite boiler characteristic and that the results will be somewhat different for other cases. The computations in this study are simplified by the fact that it was assumed that the boiler plant consisted of boilers uniform in size and characteristics. This condition does not exist in a great many plants, and it will be necessary to resort to certain expediencies in applying the method described in this article to each specific case. For instance, if the boilers are not uniform in capacity the situation may be met by assuming the various boilers as multiples of the smallest boilers. And, again, if there is a slight variation in the characteristics of the boilers a composite characteristic curve may be constructed and used, keeping in mind that when boilers are banked the least efficient ones should be banked first. If there is considerable variation in the characteristics of the boilers, it may be possible to group the boilers according to their characteristics and then treat each group as if it were a separate boiler plant, but favoring the most efficient groups in distributing the load.

A constant station steam rate of 14.0 lb. per kilowatt-hour was assumed in this example, while in most plants the steam rate varies with the load on the station and also with the season of the year. The best way to provide for a varying steam rate is to assume it to be constant up to the point where Table II is prepared, and then insert a column after the second column containing the equivalent boiler room load for the actual steam rate. Thus, if for the hour ending 1 a.m. the steam rate should be 15.0 lb. per kilowatt-hour, due to warm circulating water, etc., the equivalent boiler room load would be $\frac{19{,}320 \times 15.0}{14.0} = 20{,}700$ kw., which would be used in obtaining the total cost data. However, the total cost for the day should be divided by the actual total output of the station to determine the cost per kilowatt-hour. These are merely suggestions, as it is impossible to give specific directions to cover all cases, it being necessary to study each case carefully to arrive at the proper solution.

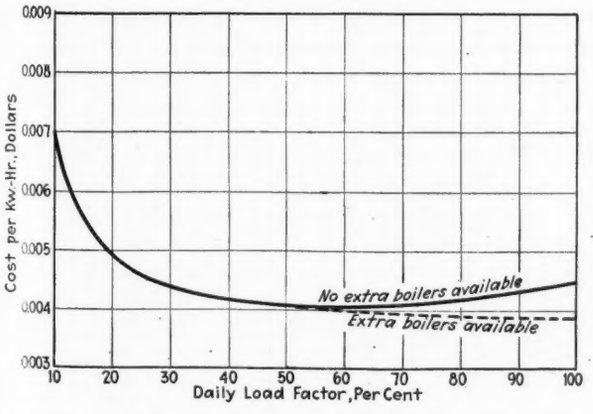


Fig. 13—Effect of load factor on operating cost

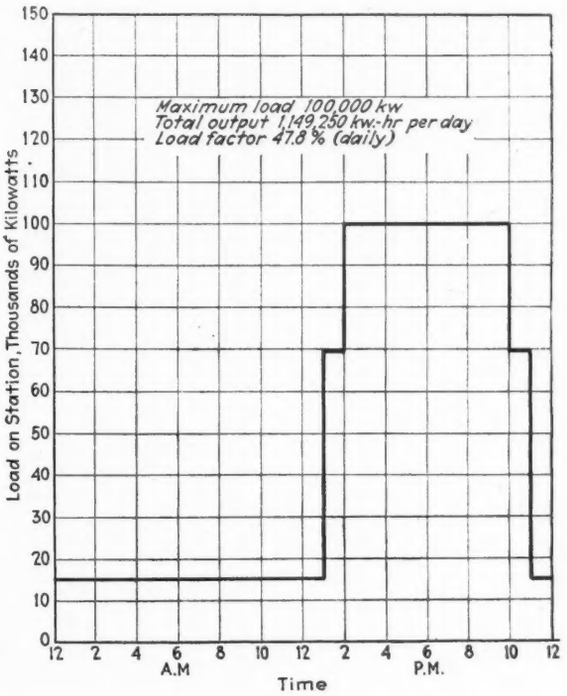


Fig. 14—Special load curve

In conclusion, it may be said that the most economical number of boilers to place in service to carry a certain load depends upon the load factor; the higher the load factor the greater the number of boilers required for the maximum economy in operating costs; while in all cases the number of banked boilers should be kept at the lowest possible minimum.

FOR THE FIRST TIME, the forthcoming census of manufactures will make available data on the amount of idle power equipment in the manufacturing plants of the country. Estimates have been made that as much as fifty per cent of the installed power in the country is idle through obsolescence, over-capacity, or other causes. Definite data, however, on this significant subject have never been made available from any source. Power installation is one of the best possible bases for industrial or market studies, but the inaccuracy of the available data, due to the inclusion of this large amount of idle power equipment, has robbed such studies of much of their potential value.

Reserve Strength Does Not Determine Wire Rope's Reserve Life

By F. A. Annett
Associated Editor, Power

Reserve Strength, *that has in general been looked upon as an important factor in the reserve life of used wire ropes on elevators and in other services, apparently does not merit the significance given it. It is shown that other factors are of equal or greater influence in determining when ropes should be condemned and replaced.*

WHEN does a wire rope turn from safe to unsafe, is a question on which there has been much speculation. If some method could be devised to determine this point it would remove much uncertainty in the condemning of ropes on elevators and other classes of hoisting equipment. There is not much doubt that most elevator ropes are removed when they still have considerable safe life remaining. With our lack of knowledge of what is safe and what is unsafe, the factor of ignorance must be set high to make sure of being on the safe side.

No satisfactory test has been devised to determine the reserve strength of a rope without removing it from service and testing it to destruction. Although reserve strength is the term generally applied to the condition of a wire rope in use, a better term would be reserve life. The two may be quite different. How long a rope can remain in service when it shows signs of fatigue and wear before it becomes unsafe is the question the users are interested in rather than the reserve strength of the rope.

At a certain period two ropes may have the same tensile strength; but due to the character of the material in them, their physical condition and the difference in service to which they are applied one may reach an unsafe condition more quickly than the other. The wire in one rope might fatigue more quickly than in another. Even though they both might show the same number of broken wires at a certain period the one that fatigues most rapidly will reach an unsafe condition in the shorter time. The size of the sheaves over which the ropes run and the condition of the sheave grooves are factors in the rate at which a rope may reach an unsafe condition. Given two sets of rope in practically the same state of wear but one running over a 28-in. and the other over a 36-in. sheave, other conditions being equal, the set on the 28-in. sheave will have the shortest reserve life.

The number of broken wires in a given length of rope is one of the common methods used when judging the reserve strength or safe life of rope on elevators and other classes of hoisting equipment. In this respect tests made by Roebling are of interest. In these tests a 6x19 rope was used of a construction similar to that in the illustration.

The construction of the rope is such that the outside layer consists of alternate large and small wires that form a round strand. In the following discussion of broken wires reference will be made to large outside and small outside wires. The tests made show the reserve strength for various conditions when using new ropes with wires cut. The results of these tests are given in the table, but only some extreme conditions will be pointed out.

Test 1—Having one large wire cut in each of the six strands at the same cross-section, resulted in a reduction of both the metal area and the breaking strength of the rope to approximately 93 per cent of the original.

Test 2—Having one large and one small wire cut in each of the six strands at the same cross-section resulted in 89½ per cent of original area and 90½ per cent of original strength.

Test 4—Two large wires and two small wires similarly cut in each of the six strands resulted in 79¼ per cent area and 83¾ per cent strength.

Test 8—All twelve outside wires cut in only one strand resulted in 89½ per cent area and 75 per cent strength.

Test 1—One large wire cut from each strand. Each wire cut three times. End cuts a distance of two rope lays from center cut. Each series of cuts in same circumference.

Test 2—One large and one small wire cut in each strand on same axis. Each wire cut three times. End cuts a distance of one rope lay from center cut.

Test 3—Two large wires and one small wire cut in each strand in the same manner as in Test 2.

Test 4—Two large and two small wires cut in each strand in the same manner as in Test 2.

Test 5—Three large and two small wires cut in each strand in the same manner as in Test 2.

Test 6—Three large and three small wires cut in each strand in the same manner as in Test 2.

Test 7—Four large and three small wires cut in each strand in the same manner as in Test 2.

TESTS OF 6 x 19 ROPES SHOWING RESERVE STRENGTH

Test No.	Number of Strands Cut	Number of Outside Wires Cut in a Strand		Percentage of Metal Area	Percentage of Original Strength
		Large	Small		
1	6	1	..	93.02	92.60
2	6	1	1	89.56	90.46
3	6	2	1	82.62	84.50
4	6	2	2	79.20	83.74
5	6	3	2	72.23	77.51
6	6	3	3	68.79	74.51
7	6	4	3	61.83	69.45
8	1	6	6	89.56	75.09
9	6	4	3	61.83	72.71
10	2	6	6	79.20	67.60
11	6	4	3	61.83	73.54
12	2	6	6	79.20	90.29
13	1	6	6	89.56	95.85

Test 8—Three sets of four wires each or all outside wires in one strand only cut. Wires cut once. Each set of four wires cut was a distance of one strand lay from the next.

Test 9—Same as Test 7, except each wire was cut but once.

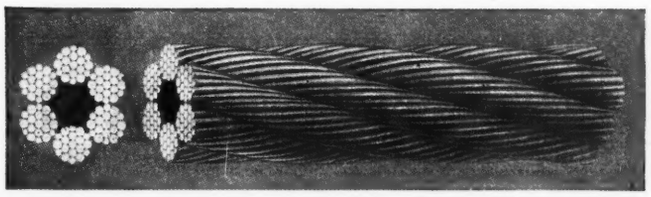
Test 10—Same as Test 8, except two strands were cut.

Test 11—Four large wires and three small outside wires in each strand cut. One large wire in each strand cut in center in same circumference. One end cut on two large and one small wire; other end cut on two small and one large wire. Distance from center to end cuts, one strand lay. Each wire cut once only.

Test 12—Same as Test 10, except that each of cuts was a distance of one rope lay apart.

Test 13—Same as Test 8, except that each set of cuts was a distance of one rope lay apart.

The examples given are sufficient to point out that where the broken wires are uniformly distributed in all six strands the reserve strength is greater in proportion than the net metallic area. It has been demonstrated by Roeblings by test that where every outside wire of all the six strands has been cut, the reserve strength is 42 per cent, whereas the net metallic area is 37.6 per cent.



Section of 6x19 wire rope

It is seen from Test 8 and also shown in Test 10 that where all the cut wires occur in one strand only, the reserve strength is less in proportion than the net metallic area. This is due to the fact that the strand that is thus cut collapses to a degree that allows the other five strands to change their relative positions and thereby reduce the original efficiency of the rope construction.

Therefore it is of the utmost importance that any condition that causes one strand in any of the ropes on an elevator to wear more than the others should be bettered or, as much as possible, done away with. The chief causes for this condition of one-strand wear are improper socketing, unequal tensions in the ropes supporting the car and worn grooves in the drum and idlers.

Unequal tensions of the ropes cause rope failure, shown in broken wires due to fatigue. Though the estimated factor of safety for a set of ropes may be 8 or 10, it has been shown that where, by unequal tensions, one rope may be carrying twice or even greater proportion of its supposed load, the combined load and bending stresses have so fatigued the steel that the wires break prematurely. The unequal tension also accentuates any faulty condition in socketing, as well as placing more load on one or more grooves of the multiple-grooved drum and idlers.

A series of tests on used elevator rope made at the University of Cincinnati for Captain M. W. McIntyre, manager, and C. B. Garrison, chief engineer, of the Central Life Insurance Building, Cincinnati, Ohio, are of interest, as they tend to show that the number of broken wires in used ropes may be an uncertain quantity by which to judge the condition of a rope. In these tests six-foot lengths of rope were used. Each six-foot section was cut in two. One three-foot length was put into a testing machine and stressed until it broke in tension. The other three-foot section was taken apart and the number of breaks in the wires counted.

There is no way of knowing that there was the same number of broken wires in the sections tested as in the one taken apart, but they should average up closely. All ropes tested were of $\frac{5}{8}$-in. 6x19-in. iron construction with a catalog breaking load of 12,000 lb. A section of a rope that had been in service for about $3\frac{1}{2}$ years and with a record of 16,113 miles, broke at 11,720 lb. An adjacent three-foot section of this rope showed 25 breaks in the wires and a wear of about 7.7 per cent. All the breaks in each strand were in one wire. In reality there were only six broken wires in the rope section. The number of breaks in each wire varied from 1 to 9. Apparently, in each strand one wire was laid up with a greater tension than the others, or the wires that failed were more brittle than the others. This rope, although showing broken wires, was in good condition and probably could have remained in service considerably longer before reaching an unsafe condition.

In a number of sections tested from other ropes a similar condition was found. All the breaks in each strand were concentrated in one wire.

Sections were tested in which the breaks were not all confined to one wire in each strand. For example, one three-foot section was taken apart in which all twelve of the outside wires in each strand were broken. The total number of breaks was 230, and the total wear amounted to about 20 per cent. An adjacent three-foot section of this rope broke at 10,950-lb. load. This section, although it was approaching an unsafe condition, developed a breaking strength well up toward that of a section taken from a rope apparently having considerable reserve life. These tests indicate that even if the reserve strength of a rope could be determined in service it would not necessarily be a measure of the safe reserve life in the rope.

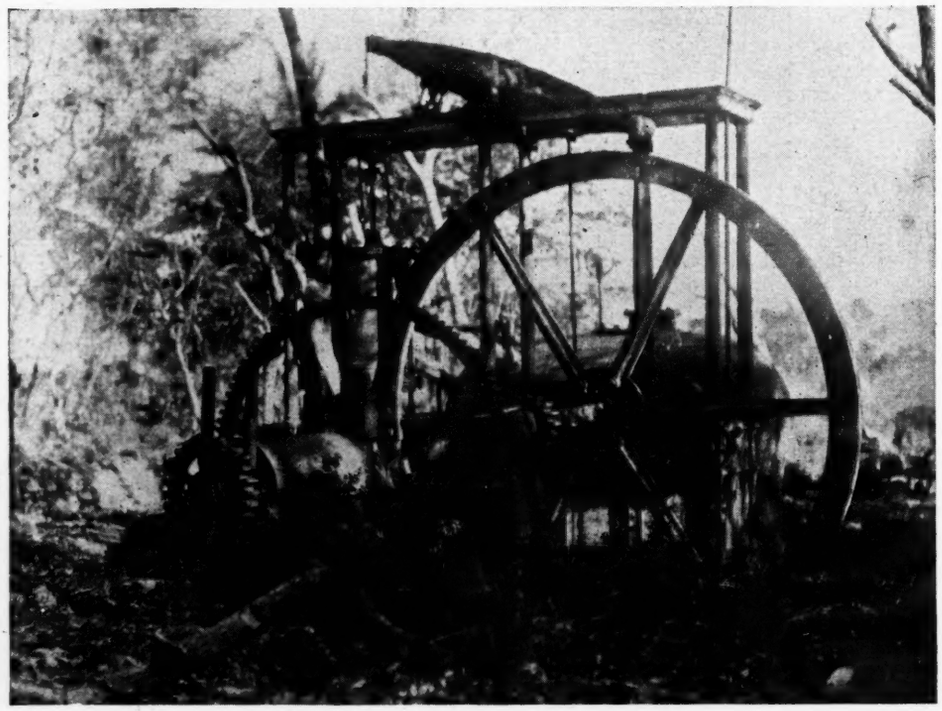
Notwithstanding the fact that ropes removed from service will in most cases develop a large part of their rated strength when new, they do fail unexpectedly and without warning. One in a group of hoisting ropes on a traction elevator failing unexpectedly might be accounted for by unequal loading due to unequal tread diameter of the grooves in the sheaves. However, when the governor ropes on three elevators go bad at the same time it cannot be accounted for by loading of the ropes. In this case the ropes had been in service about six months. Two of the ropes were removed when they showed conditions that apparently were unsafe. The third rope was left in service because of a dispute over its condition, and in a few days decided the argument by parting and falling down the hoistway.

These inconsistencies in the action of used rope clearly indicate that the reserve strength of a wire rope, even if it were known, cannot be used as a guide to its safe reserve life, unless considered with other factors. One of these is the rate at which broken wires occur in the strands and the location of these wires. If on one inspection a few broken wires only were found in a set of ropes, but on the next inspection many broken wires were found, it would be an indication that the ropes were failing rapidly and should be replaced. On the other hand, a set of ropes having the same number of broken wires as the first, but in which they had developed gradually, might be considered safe to go to the next

inspection. Ropes used in moist places that have been allowed to rust must be given special consideration. When ropes are kept well lubricated rarely do broken wires occur on the inside of the strands. All wires generally fail on the outside, where they can be seen. When ropes are allowed to rust, wires are likely to fail on the inside of the strands where they cannot be seen, which adds to the uncertainty of judging their condition. The lack of lubrication in the strands causes high stresses to be set up in the ropes, when they bend around the sheaves and may fail quickly.

Rules for deciding when ropes are sufficiently worn to require replacing are not easily formulated. Ropes working under severe conditions of heavy loads, reverse bends and continuous service should be discarded when they reach a state that under more favorable conditions would allow keeping them in service several months. A rule followed by many inspectors is, under average conditions, to condemn a rope when six wires are broken in one strand lay. This rule, combined with sound judgment and experience, is probably as good as any that has been devised. It is not generally expected that the last minute of useful life is to be gotten out of any machine part that wears—then why out of wire rope?

Selecting ropes best suited to the service, properly installing and maintaining them, keeping the sheaves and other parts in good condition and providing means to equalize the loading on the ropes will do more toward getting long life out of them than any attempt to keep the ropes in service after they show signs of weakening. We may not be able to tell the reserve life in a used wire rope, but many of the conditions that contribute to short rope life are controllable. Attention to these conditions will do much to extend the life of ropes before they come into the zone of speculation, when it is good practice to condemn them to insure, being on safety's side.

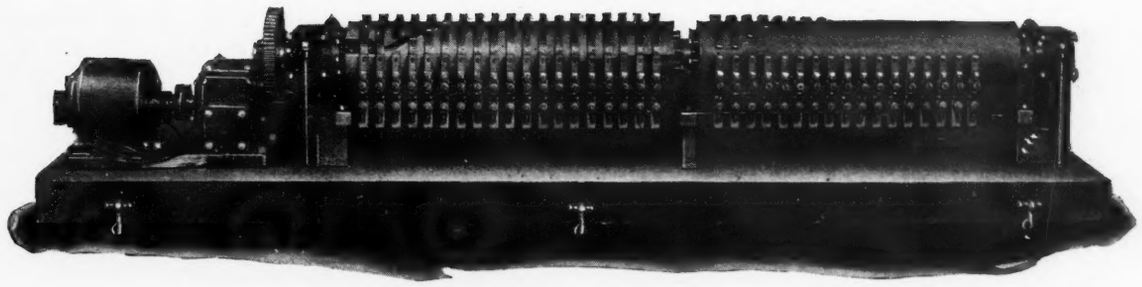


Gone Are the Days . . .

when the creak of this old sugar plantation engine, mingled with echoes of "Yo Ho Ho, and a Bottle of Rum," penetrated into the Haitian jungle. Embossed on its cylinder casing, along with those curlicues in bas-relief so dear to the hearts of the early engine builders, is this inscription: "Joseph Lindsay & Company, Haigh Iron Works, Near Liverpool, 1818."

The engine is of one cylinder, with a slide valve and a walking beam geared to a flywheel that in turn is geared to rollers, which squeezed sugar from the cane back in the "good old days." The cylinder is about 24 in. in diameter and has a stroke of about 4 ft. Behind the engine can be seen the outline of the boiler. No problem of overfire air troubled the minds of these pioneer builders. It has no firepit, no grate, and above it there is nothing but the bright blue sky. A low wall surrounds the bare ground on which the fire was built.

The strange thing about this engine, the thing that makes it stand out amid the surrounding ruin, is the fact that corrosion, except for slight rusting, is well-nigh absent.



Motor-driven drum for the variable-speed control

VARIABLE SPEED CONTROL *for A.-C. Motors Driving Pumps*

By P. B. HARWOOD
Electrical Engineer, Cutler-Hammer, Inc.

CONTROL equipment for the motor of the main sewage plant at Chester, Pa., has a number of unique features. The pump house adjoins a storage reservoir. There is a pump pit containing four electrically operated centrifugal pumps, with space for a fifth pump to be added at some future date. Two of the pumps are automatically operated and start when the water level in the storage reservoir reaches a predetermined height. The pump speed and discharge increase as the water rises in the suction well and decrease as the water lowers. The other two pumps are manually operated.

One pump is driven by a variable-speed motor and has a capacity ranging from 2,000,000 to 7,000,000 gal. per day. Another pump is equipped with two variable-speed motors and has a capacity of from 7,000,000 to 13,000,000 gal. per day. The other two pumps are driven by constant-speed motors and each has a capacity of 13,000,000 gal. per day. All pumps discharge into a 36-in. main running along one side of the pump pit.

Two constant-speed and two adjustable-speed pumps are driven by alternating-current motors. The control on the adjustable-speed units automatically gives sixteen speeds from a float switch of unique design. A two-inch change in water level produces a change in speed

The constant-speed motors are rated at 250 hp., 2,200 volts, 2 phase, 60 cycles. They are controlled by auto-transformer starters manually operated. There is nothing unusual about these two motors and their control, therefore this article will deal with the control for the two variable-speed units.

On one of the pumps the variable-speed motor is rated at 100 hp. and is of the slip-ring induction type. As previously mentioned, another of the pumps is driven by two motors. One of these motors is rated at 125 hp., the other at 250 hp. The smaller motor is used at the low speeds, the larger motor at the high speeds, giving an increased efficiency for the equipment over that which could be obtained with only one motor. Regulation is obtained on the variable-speed motors by resistance in the secondary circuit. This resistance is cut out and into the rotor's circuit by magnetic-contactor type switches.

The control for each motor consists of a primary oil switch magnetically operated, and a set of magnetically operated secondary contactors under the control of three-phase series relays. Thermal relays operated from current transformers provide overload protection. A total of seven speeds is obtained on the 100-hp., four on the 125-hp. and five on the 250-hp. motors. These make a total of sixteen speeds over the complete range of the variable-speed motors. Fig. 1 shows the control panels. The magnetically operated oil switches are on the rear of the board and do not show in the photograph.

The speed of the pumps driven by the variable-speed motors is in accordance with the rise or fall of the water level in the pump pit. There is a float switch with total of sixteen points, or one for each speed of the three motors. At the lowest level the 100-hp. motor is started, and if the water level rises the speed of this motor is gradually increased point by point until it is running at the maximum speed on the seventh point.

Each point on the float switch represents a rise of two inches in water level. When the eighth point is reached on the float switch and the water continues to rise the 125-hp. motor on the pump driven by two motors is started and the motor on the small pump is shut down. Continued rise of the water will speed up the second motor to its maximum on the fourth point. The next point shuts this motor down and starts up the 250-hp. motor on the same pump.

The float switch does not operate directly upon the contactors of the control board, but controls a motor-driven drum. This drum is shown at the top of this page. The cylinder of the drum has two parts, the first being in the nature of a limit switch or follow-up device which stops the drum at the proper point. In other words, if the float switch is moved around to the eighth

point the drum will follow up to the eighth point also and will be stopped there by its limit switch. Correspondingly, for any point or position taken by the float switch the drum will move to a corresponding position.

Segments for handling the control contactors are contained on the second part of the motor-driven cylinder. These are arranged in such relation with the limit switch that when the drum takes up any given position corresponding to a float-switch position the proper motor and speed will be selected. The drum is driven through a gear reduction by a $\frac{1}{8}$-hp. 1,800-r.p.m. 220-volt, 2-phase motor. Power for this motor and for the control circuits of the board is obtained from the main line through step-down transformers. Since the drum must run in either direction, depending upon whether the water is rising or falling, the motor is reversible.

The drum switch is simply constructed, as can be noted from the picture. The fingers are mounted on a square steel shaft insulated by mica tubing. The cylinder instead of using cast-iron sections, as is common practice, consists of a piece of four-inch pipe turned smooth and slotted to obtain the necessary insulation. The slot may be seen in the left-hand portion of the cylinder. The gear reduction is inclosed and runs in oil, and a cover, not shown in the photograph, incloses the whole mechanism.

Fig. 3 shows the float switch, which is also of a unique construction. Since it was necessary to get from one point to another on a two-inch change of water level and also because the diameter of the float pipe was quite small, it was necessary to design a float-switch mechanism that would operate on light pressures. A quick make-and-break switch with a star wheel that would lock it definitely in one point or another was required, because the change of water level will be slow. It was also necessary to reduce the friction to a minimum to get accurate operation when the direction was reversed, as when the water stopped rising and started to fall, or vice versa.

It has been the practice with this kind of equipment to use a float switch with a double-sheave wheel having the float attached to one part and a counterweight to the other. In this case there was not sufficient power to operate such a device, and therefore the float was directly connected and the counterweight omitted. A system of chains and pulleys was provided and the float rod permanently fastened to the chain, as is shown at *A* in Fig. 3. The actual distance between the top and bottom sprockets need be only a little greater than the total travel of the float, which is 30 in. These sprockets all operate on ball bearings to reduce friction.

The float-switch mechanism proper consists of a slate having a row of button contacts and brush contacts riding on these buttons. The brush contacts are mounted on a plate connected to the main driving sprocket through a spring. As the float operates and turns the sprocket this spring is wound up and when the tension reaches a sufficient amount it snaps over the brush from one position to the next.

There is a star wheel also on the float switch, which insures the brushes being on one point or another. This device proved to be quite accurate and to operate on extremely low pressures, corresponding to small changes in the water level. On the float the star wheel is so arranged that each position definitely represents a two-inch change of water level, required by the specifications.

In order to insure operation in case of trouble or breakdown of any part of the apparatus, there is a transfer panel, Fig. 2, and provision made for operating all of the pumps manually. The knife switches shown on top of this panel are for the control circuit and for the pilot motor of the motor-driven drum. Below these knife switches are two transfer switches and several push buttons.

By means of the transfer switches it is possible to disconnect either pump from the float switch and motor-driven drum and connect it to a separate manually operated master controller. When this is done the push

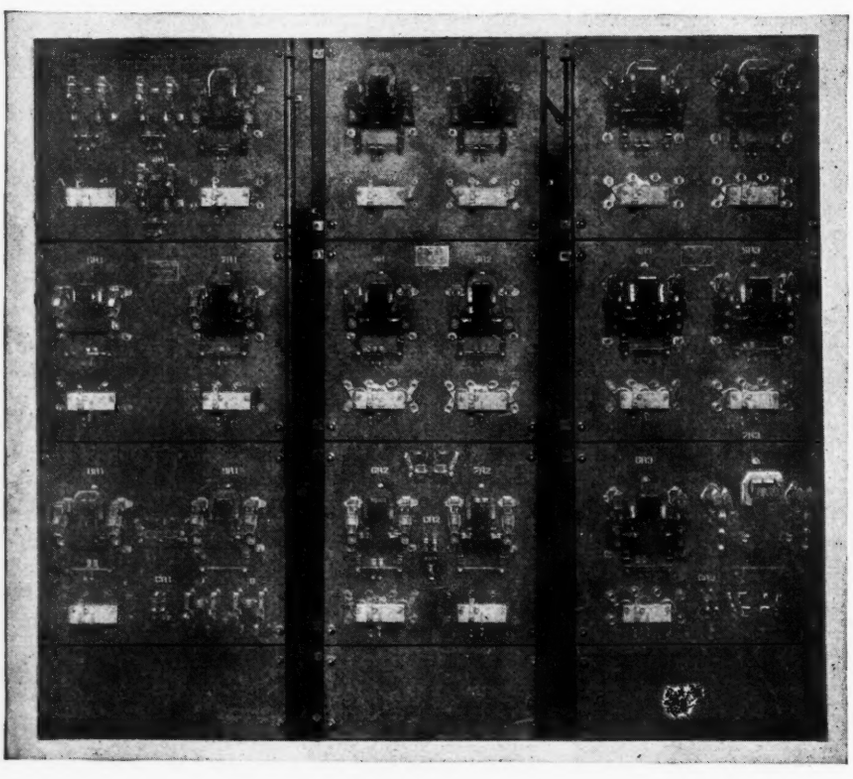


Fig. 1 (Left) —Control panels for the variable-speed motors

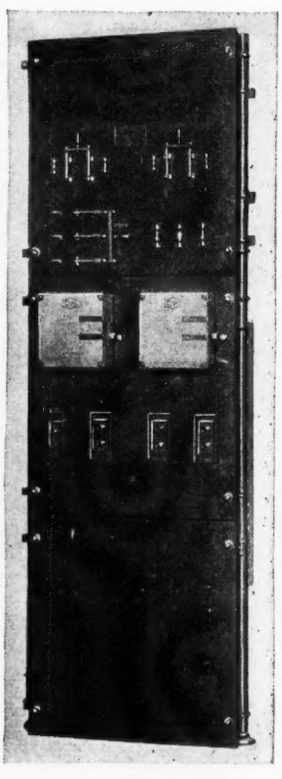


Fig. 2 (Right) —Transfer panel for changing from automatic to manual control

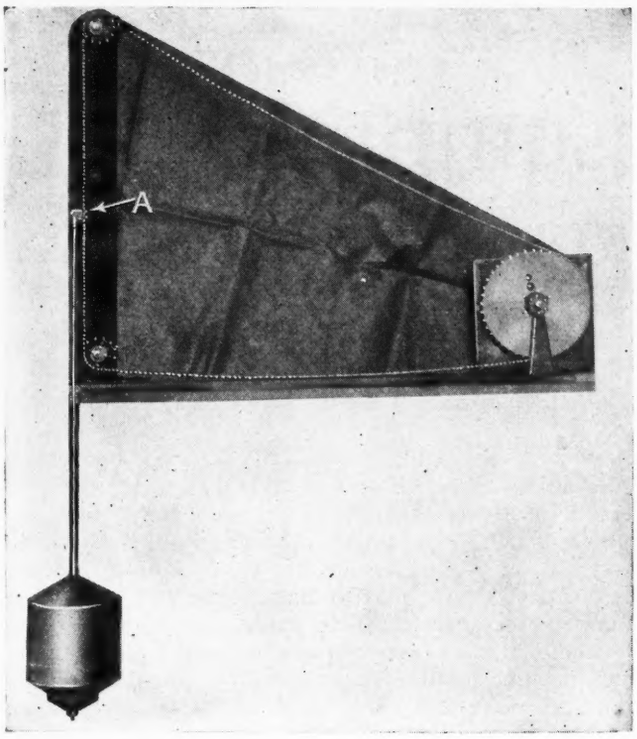


Fig. 3—Float switch designed to operate on light pressures

buttons control the main primary oil switches of the motor, and the manually operated master controls the secondary magnetic contactors. In other words, under manual control the motor is started and stopped from the push button and the speed is selected by means of a separate master.

The automatic system described, together with the two manually started pumps which the operator has at his disposal, gives the operator an arrangement that allows a good pumping efficiency at all times. Continued operation is assured through the flexibility of control.

Motor Performance Enhanced By Careful Inspection

By Marin Phillips
Electrical Superintendent, International Paper Company Niagara Falls, N. Y.

ONE of the operating department's jobs is to keep power on the lines and the motor and other equipment running. To do this requires a careful system of inspection. Following is a set of rules to assist in making motor inspections:

Inspect all motors daily and oil them when needed. Blow them out with compressed air once a week. Be careful to have the air dry before directing it on the winding. Do not hold your hand in front of the air nozzle while waiting for it to dry. There may be pipe scale and dirt in the air that will cause an injury.

Wipe off all dirt, dust, grease and oil from the motors and starting equipment, once each week. Under very dirty conditions cleaning more often may be necessary. Do not attempt to do any wiping or cleaning on a motor while it is running—the risk of getting hurt is too great. When cleaning heating-fan motors, shut them down, and start them up again when through.

Be careful not to use too much oil in motor bearings. When a bearing needs oiling, pour in a little at a time until it rises to the proper level in the oil gage. Oil will leak out of some bearings if carried level with the top of the oil gage. Oil in a bearing will seek a level, and it cannot be kept any higher. Any more added will run out into the windings. The correct oil level may be anywhere from a full gage to one-half full. Study each motor to determine the correct oil level.

Any time that there is doubt about the oil level being too low, look at the oil rings. If they pick up oil freely, it is high enough in the gage. When making a study of a motor to determine the proper oil level, visit it several times during the day, to guard against the possibility of the oil getting low enough to burn out the bearings.

Oil should never be poured into a bearing until it is level with the top of the oil gage while the motor is running. The rings keep a certain amount of oil in suspension that will settle back into the reservoir and overflow on to the motor base and floor when the motor is stopped.

Report any motors that are found to have an excessive amount of vibration. Also report any motors that need oiling frequently. Make all reports in the form of a written note. This will insure better attention, as there is not so much danger of forgetting it.

Clean up any oil spots found on the floor caused by the motor. Note the bearing temperatures. When any are found hotter than normal, see if the oil rings are turning. If the rings are turning and the oil level is correct, it will be necessary to slack off the belt sufficiently to cool the bearing.

When making motor inspections, see that no belts are loose enough to slip and interfere with the machine's operation. On the other hand, see that no belts are tight enough to overheat the bearings. When a motor bearing burns out, if possible, get the belt off immediately before the bearing has a chance to cool off and seize the shaft.

When a belt is tightened, watch the motor bearings for the first half hour afterward to see that the bearings do not overheat. When a new motor is installed see that the oil rings are in place and turning. Also watch the bearings for overheating.

When a new rubber belt is put into service it should be treated with belt dressing for the first few days, to make it pliable enough to prevent slippage without excessive tension. Use belt dressing sparingly. Do not put too much on or spill it on the floor. Immediately report all belts that are found badly worn or with loose piles flapping.

Report all motors or starting equipment found to have broken or disconnected ground wires. Also report any bare wires or badly insulated joints.

Report any oil gages that are on the inside of the bearing near the belt, and gages partly filled with dirt.

When a motor is disconnected for removal, first draw the oil out of the bearings to prevent spilling it on the winding and floor. Return any used oil to the oil house to be filtered and used in bearings of less importance.

Report motors requiring covers. Report any electrical equipment found with water dripping on it. Report switches or starting equipment that are rusting and in need of painting. Report brushes sparking or badly worn.

When cleaning, look for defects in the equipment. Do not clean near any live parts of the equipment. Do not use an air hose with a metal nozzle near any live busbar work.

Calculating the
Steam Consumption of SMALL TURBINES

To predict the steam consumption of turbines involves a vast amount of complex calculations. This article shows how charts applied to the steam-rate calculations of small single-wheel re-entry-type turbines greatly simplifies the work.

By W. A. BLAKESLEE
Small Turbine Engineering Department
Westinghouse Electric & Manufacturing Company

THERE are many factors that influence the steam rate of a turbine, some of which may be listed as follows: steam pressure and quality of superheat at the throttle, pressure at which the turbine exhausts, horsepower output, and speed turbine.

In addition to these factors, all of which vary, the manufacturer is confronted with the following design variables, which, when once fixed, apply to an established line of certain sized "frames" and limit the range of their application:

1. Steam nozzle of definite port design, the angle of exit being fixed within narrow limits.
2. Rotor diameter, which determines the blade speed for a certain r.p.m. The rotor must be designed for the limiting speed that the builder has in mind.
3. Choosing of blades, as to inlet and exit angles, width, height, and number per rotor.
4. Reversing element, the inlet and exit angles being fixed.
5. Size of steam chest, which must be established so that there will be the least practicable pressure drop for the maximum output of the turbine with the lowest prospective steam pressure.
6. Size of exhaust, determined so as to build up little back pressure in the turbine cylinder for the maximum steam flow contemplated.

To calculate the steam rate of a turbine from fundamental data, it is necessary to utilize the knowledge of the properties of steam, particularly those properties that have to do with adiabatic expansions such as take place in turbine nozzles. The velocity of the steam as it leaves one of the commercial types of nozzles must be determined. The work done by the steam impinging upon, and the reaction leaving, the turbine blades must be closely estimated. This energy conversion is influenced by the nozzle angle, the blade inlet and exit angles, the loss in the blades, their width, pitch, and speed, as well as by the design of the reversing element, which redirects the steam into the blades. Where there are so many factors bearing upon the final result, it may easily be seen that the calculations become quite lengthy and wearisome. Furthermore, a complete set of calculations must be made from the ground up for each new set of working conditions. These calculations involve a tremendous amount of detail, starting with the available heat drop and working through the nozzle design and velocity diagrams, and ending with the various unavoidable mechanical losses. It is also evident that empirical constants must necessarily be freely employed. Only after years of practice are these empirical constants established to the point where close predictions of a steam rate may be made. A large part of these steam rate calculations may be greatly simplified by the use of charts.

The total steam consumption in pounds per hour of a turbine is made up of two parts; first, that due to losses, and, secondly, that part due to the horsepower output of the turbine multiplied by what we may call the "indicated" or "internal" steam rate of the turbine.

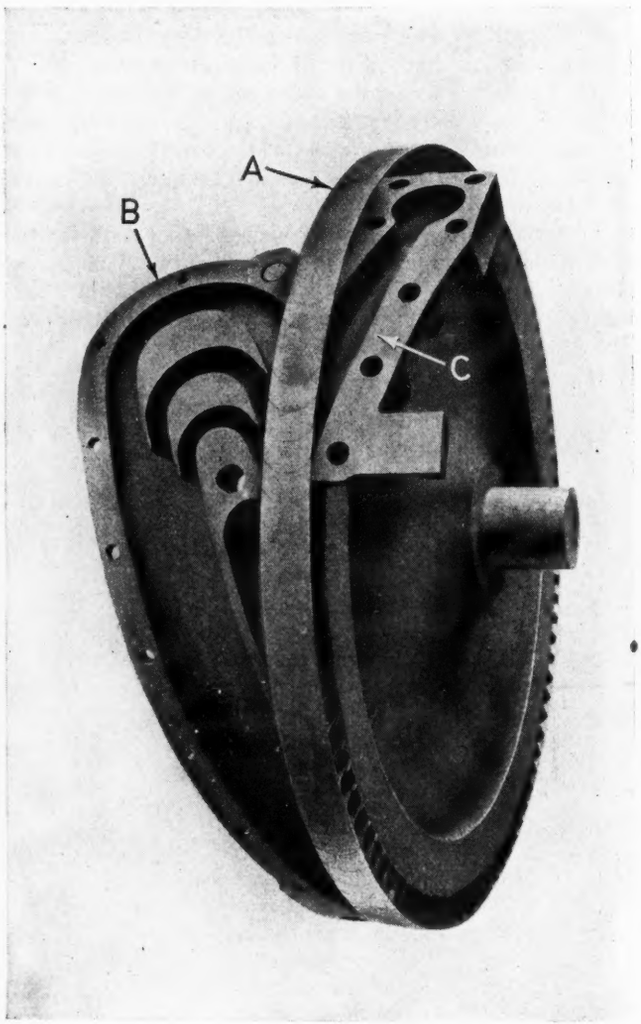


Fig. 1—Typical re-entry-type turbine wheel and nozzle
A blades, *B* reversing element, *C* nozzle.

The internal steam rate of a turbine depends upon the steam conditions (pressure and superheat at the throttle, and exhaust pressure) and the r.p.m., assuming that the rotor and blades have been chosen. For any given steam expansion conditions we will have a certain heat available, expressed in B.t.u. per pound of steam, which is dependent upon the pressure drop and affected by the loss of pressure through the steam chest and the efficiency of the nozzle. The pressure drop through the steam chest may be taken as constant, as a proper choice of the governor valve size will be made. The efficiency of the nozzle may be determined so that, with given steam conditions, a chart similar to Fig. 2 will give the heat drop.

With the heat drop determined, we apply that value to another chart, Fig. 3, to determine the internal steam rate of the turbine.

Losses are made up of a number of items, including the minor bearing and governor losses, and the major loss due to the skin friction of the rotor disk. The bearing loss is small and may be considered constant for all practical purposes. The rotor friction increases rapidly with the diameter of the rotor, with its speed and with exhaust pressure or density of the medium in which it revolves. It is for this reason that superior economies are obtained by revolving one small diameter rotor at a high speed in order to obtain the benefit of high blade speed and yet secure the advantages of low rotor-disk loss. The rotor is then geared to give the desired final speed.

As the density of the steam in the turbine cylinder is, for all practical purposes, a function of the back pressure in the cylinder, the friction loss of a rotor of definite diameter and shape may be expressed in horsepower, depending upon its speed and the back pressure in the turbine cylinder. The total losses in pounds per hour are then the sum of the bearing losses plus the rotor friction loss, expressed in horsepower, multiplied by the internal steam rate of the turbine. Or the loss in pounds per hour may be read directly from a chart, such as Fig. 4, for the rotor of a certain frame.

The total steam consumption in pounds per hour will then be the internal steam rate multiplied by the brake horsepower output of the turbine, plus the losses in pounds per hour, and the steam rate of the turbine in pounds per brake horsepower per hour will be the total steam consumption in pounds per hour divided by the brake horsepower.

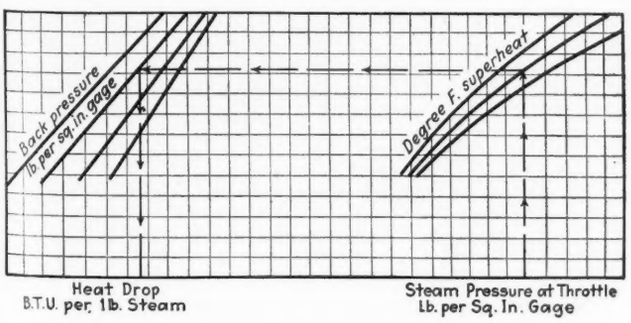


Fig. 2—Chart for obtaining effective heat drop

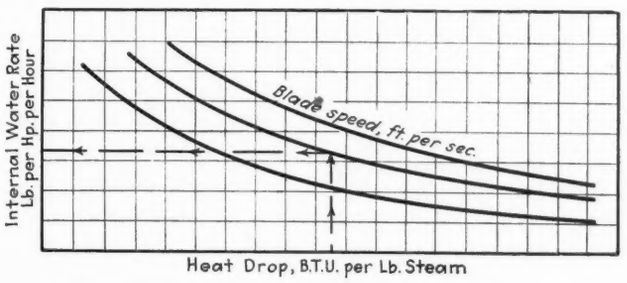


Fig. 3—Chart for finding internal steam rate

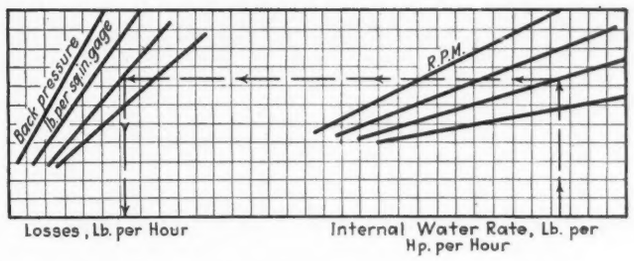


Fig. 4—Chart for finding total losses

The steam rates at partial loads are figured in much the same manner; keeping the following facts in mind:

1. The curve of steam consumption in pounds per hour plotted against horsepower output obeys the Willans straight-line law. Hence it is only necessary to find the horsepower output at one other steam flow beside the full-load point, and then connect the two points with a straight line to give the steam-consumption curve for that nozzle or group of nozzles. If the curve for a different combination of nozzles is desired, new curve values for this combination must be calculated.

2. The flow of steam in pounds per hour through a nozzle varies directly as the absolute pressure at the entrance to the nozzle. Or, for one-half the absolute pressure there will be one-half the steam flow.

It is assumed that the full-load steam consumption has been found. For convenience, the horsepower delivered at one-half the full-load steam flow will be calculated. The pressure at the nozzle entrance will then be one-half the full-load nozzle-entrance pressure, and the new heat drop, allowing for an incorrect nozzle-expansion ratio (since the expansion ratio is determined by the full-load steam conditions it cannot be correct for the half-flow expansion), may be taken from a chart similar to Fig. 2 except with different heat-drop values. The internal steam rate is then read from Fig. 3, and the losses with that internal steam rate from Fig. 4. The losses are subtracted from the half steam flow, and the remainder divided by the internal steam rate, which then gives the horsepower output of the turbine for one-half the full-load steam consumption. The two points are thus fixed to locate the steam-consumption curve.

Turbines are frequently sold designed to carry a certain load with one set of steam conditions, and then steam rates are requested with a different set of steam conditions; often times with a different nozzle combination. These cases involve considerable calculations that are difficult to reduce to chart form.

THE TIME IS PAST when huge clouds of smoke belching from the stacks of factory and power plant are taken as a sign of industrial activity and efficiency. Smoke today means but one thing—a poor job of combustion, and men in industry are fully as loath to have a goodly percentage of their useful fuel broadcast over the countryside as residents of the countryside are to receive such an unwelcome gift of soot and grime.

Feed Pump *Problems* *Caused by* High Pressure *and* High Temperature

By R. W. Miller
Witten, Germany

THE development that has taken place in boiler construction and operation in the last few years is characterized by two features, a considerable increase in steam pressure, and feeding the boilers with water as hot as possible. As is well known, the critical point of 3,200 lb. per square inch has already been reached in the Benson boiler, while other boilers operate at pressures of 800 and 1,400 lb. In modern boiler plants the feed water is introduced at temperatures of 300 to 400 degrees.

A number of new problems have consequently been encountered that affect auxiliary equipment. While the designs of boiler plants and of steam engines and turbines suitable for these more severe conditions of temperature and pressure appear to be temporarily settled, new designs and constructions are still being investigated and tried, particularly in connection with boiler-feed pumps, the first designs not having been found entirely satisfactory.

The specific gravity of water varies with the temperature, as shown in Fig. 1, and is a property that should

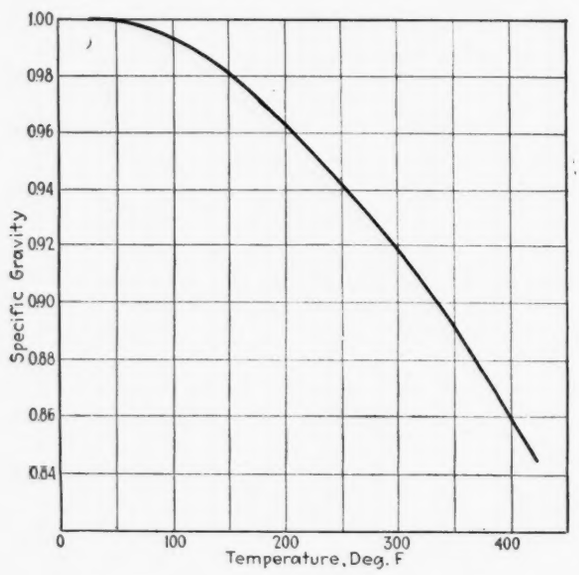


Fig. 1—Specific gravity of water at high temperatures

not be neglected in feed pump design. A feed pump nominally delivering 140 g.p.m. against a head of 700 ft. (300 lb. pressure) would probably be found satisfactory for supplying water at 140 deg. to a 250 lb. pressure boiler having 8,600 sq. ft. of heating surface. But to supply water at a temperature of 300 deg. to the same boiler when steaming at the same rate, the pump must be capable of supplying 152 g.p.m. against a head of 765 ft. (300 lb. pressure) in order to attain the same results. The feed-water pump must therefore have passages of greater sectional area and impellers of greater diameter or be run at a higher speed.

Another point that should be considered when dealing with hot water is the head under which the water flows to the pump, and the design of the pump inlet.

The suction capacity of a centrifugal pump diminishes as the temperature of the water increases. With cold water a pump can operate with a maximum suction lift of about 23 ft. The rate at which this decreases with rise in temperature is shown by curve *S* in Fig. 2.

Water at a temperature of 160 deg. cannot be drawn up by an ordinary centrifugal pump. It can only be pumped when it arrives at the pump under a pressure at least high enough to overcome the frictional resistance in the pump inlet. With water at a temperature of 200

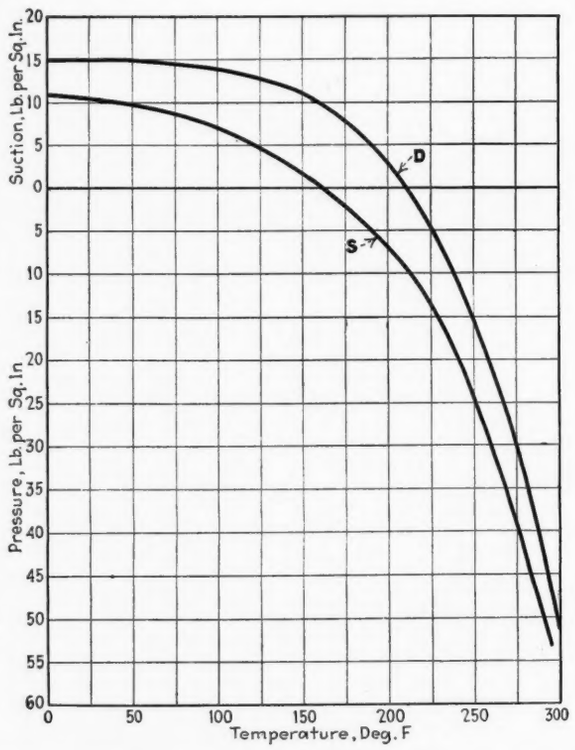


Fig. 2—Pressure required at pump inlet for various water temperatures

deg. the pressure head before a pump of the usual type must be at least 6.4 lb. gage, measured at the pump inlet.

If the temperature of the feed water exceeds 212 deg., it must be under a pressure at least equal to the vapor pressure, shown by the curve *D*. Water at 212 deg., for example, will only be prevented from turning into steam when it is kept under a pressure of at least 14. 7 lb. abs. The pressure at the pump inlet must then be greater than this, as shown by curves *S* above 212 deg., the difference between the vapor pressure corresponding to the water temperature, and the necessary pressure at the pump inlet is practically constant.

The numerical values given in Fig. 2 should be used with a factor of safety to allow for sudden fluctuations in demand and unexpected increases in temperature.

The constant increase in boiler pressure has resulted in corresponding increases in the power required to drive the boiler-feed pumps, and it is desirable to obtain sets with high efficiencies and as adaptable as possible to varying

load conditions. This is possible by carefully choosing the most appropriate type of prime mover and the best method of governing.

The feed pumps must be at least large enough to supply water to the boilers when operated at maximum rating. If the pump is driven by a constant-speed motor, its discharge must be throttled when the boilers operate at normal ratings, since the delivery head increases as the quantity delivered decreases. Consequently, in order

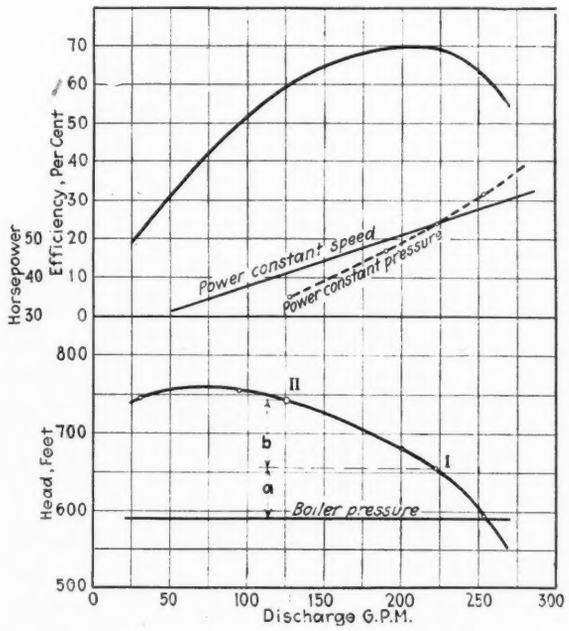


Fig. 3—Curves showing energy lost by throttling, a constant-speed pump

to deliver the normal quantities of water, energy must be lost. The lower curve in Fig. 3 shows the relation between delivery and head at constant speed, a indicating the amount by which the pressure developed in the pump must exceed the boiler pressure, P_b; the pump pressure is therefore composed of $P_b + a + b$.

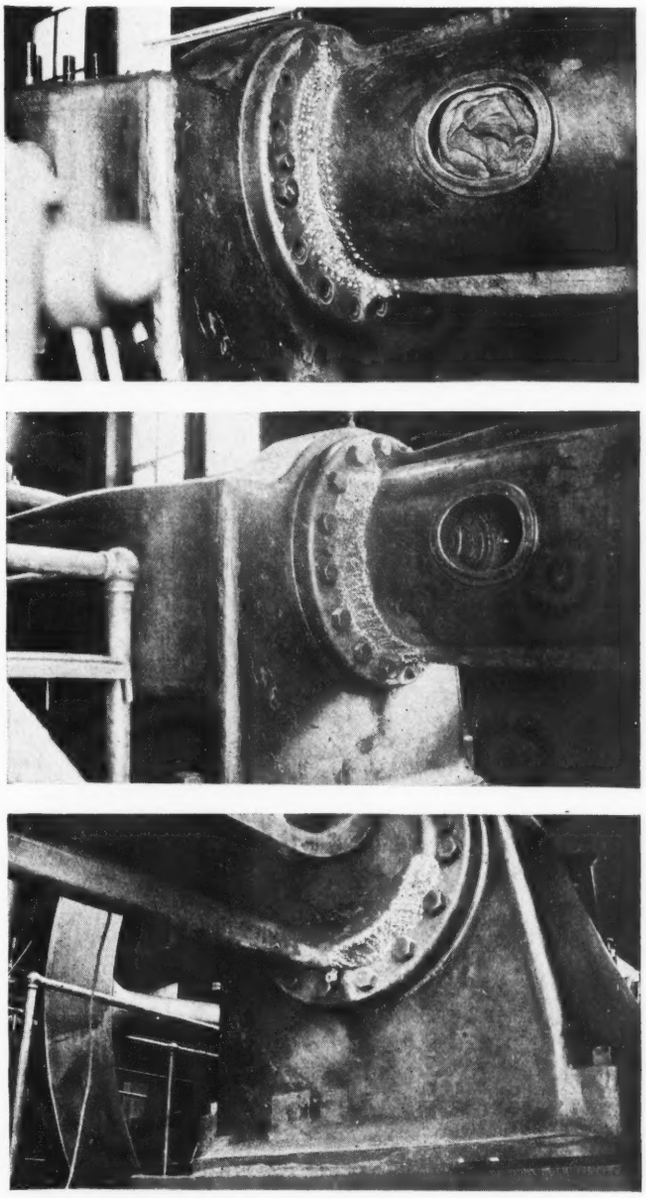
When the pump is working at full capacity (point I) the additional pressure b is zero. When the quantity of water delivered to the boiler decreases, the delivery head will rise, although the boiler pressure P_b remains constant, and the amount of throttling by the governing device is indicated by b. On the other hand, in consequence of the rapid fall in the pump pressure, it is not possible to proceed to any considerable discharge greater than point I. Point II corresponds to normal service conditions. Point I will come into consideration only in exceptional cases when the boiler is forced or when the work done by another pump set has to be supplemented. The decrease in power required to drive the pump if the pump pressure is held constant by a speed-regulating device, which automatically adjusts the balance between the quantity of feed water delivered and the delivery head, is shown by the horsepower curves in Fig. 3.

If the normal quantity of feed water delivered by the pump is about 35 per cent less than its maximum capacity a pump running at constant speed will absorb, in round figures, about 15 per cent energy more than a pump that has automatic speed regulation. In making this calculation, no account is taken of the fact that the efficiency of a centrifugal pump generally increases with increase in speed.

Ammonia Compressor Repaired by Arc Welding

ELECTRIC arc-welding saved time and money recently in a large ice plant, when a crosshead guide casting on a 500-hp. ammonia compressor cracked three-quarters way around the cove formed by the wall and flange.

In preparing the part for welding the crack was first V'd out with a pneumatic chisel. Half-inch studs, projecting about $\frac{1}{8}$ in. above the surface, were placed about the crack as shown in the upper photograph. A layer of metal was then welded around each stud and across the cast iron. After this, weld metal was deposited in the V'd crack, one layer at a time, until it was filled;



Top—Studs in place ready for welding. Center and Bottom—Views of finished weld

then about $\frac{1}{4}$ in. of weld metal was deposited above the surface of the casting as a reinforcement.

Current for the welding was supplied by a "Stable-Arc" welder of 200 amp. capacity, the work being done by the Quick Welding & Machine Company, Terre Haute, Ind.

Diesel Engines Reduce Municipal Power Costs

By G. Grow

THE Higginsville, Mo., municipal light and water-works plant has, through the installation of Diesel generating units, become a profitable undertaking. Power is produced at a generating cost of less than 1c. per kilowatt-hour with a plant load factor of about 35 per cent.

Originally this plant was driven by steam equipment of somewhat antiquated design. With the rise in coal and labor costs such operation became well-nigh prohibitive. The boilers were old and the repairs to furnaces, tubes and shells grew to alarming proportions. As a solution, the town purchased two two-stroke-cycle solid-injection crankcase-scavenging Diesels in 1925. One of these is rated at 360 hp. and the other at 240, both are direct connected to alternating-current generators, with belted exciters.

The municipality had no funds, and its bonding limit was so nearly approached by outstanding issues for water-works that the machinery had to be purchased on a monthly payment basis. The cost of the generating units and their accessories was $62,200. The agreement was to pay $1,124.80 per month, with the unpaid balance carrying 6 per cent interest.

By 1928 the load had increased to a point where more generating capacity was needed. Consequently a 560-hp. unit of the same make was purchased and installed in September, 1928. Payment for this was likewise on a monthly basis; the unpaid balance on the other two engines was consolidated with the new purchase and monthly payments of $1,448 for 48 months were arranged.

In 1928 a total of 1,187,493 kw.-hr. was generated. The itemized costs were as shown in the table.

During 1929 the operating cost has ranged from 9 to 9.8 mills, the lowest cost occurring during the summer, when the water-works demands, as well as the increased commercial electrical consumption, raised the monthly plant load factor.

In the labor item is included one-half of the superintendent's salary, the balance being charged against the water-works department. In spite of there being three engines, only one man is used per shift of eight hours. The operator also attends to the water-works pumps, located in a room adjoining the engine room.

The lubricating oil cost is about the usual rate for this type of engine where the machine is run underloaded, for it is engine-hours run and not kilowatt-hours output that determines the lubricating oil consumption of a Diesel engine. The total listed in the tabulation includes the initial 375-gal. charge for the crankcase of the 560-hp. unit. The lubricating oil is passed in batches through a Sharples centrifugal separator, with a daily addition to offset losses.

GENERATING COSTS IN 1928

	Total Costs	Cost per kw.-hr., Mills
Fuel oil, 128,000 gal.	$5,887.92	4.95
Lubricating oil, 2,284 gal.	1,209.12	1.02
Waste and supplies	208.63	0.18
Labor	4,170.00	3.51
Repairs to engines	926.15	0.79
Heating building	42.85	0.04
Total	$12,444.67	10.45

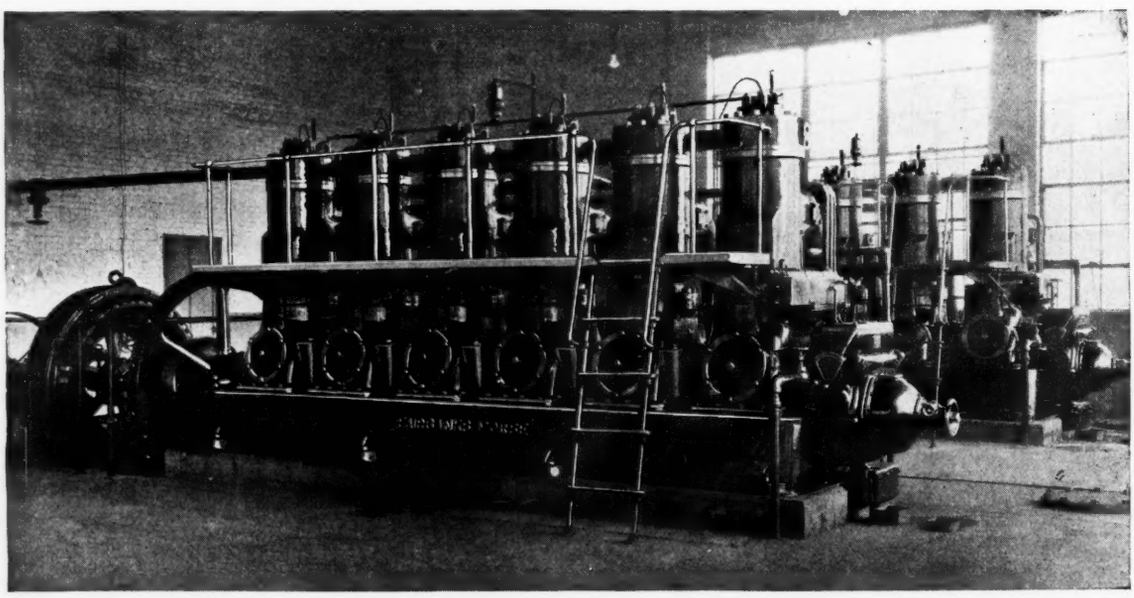
In the item covering the repairs to the engine is included the labor as well as the cost of the new parts.

No silencers are used on the engines, but each has an exhaust pit, which reduces the noise to a minimum.

Cooling for the engine is by water from a cooling tower. Motor-driven centrifugal pumps lift the water from the tower sump and force it through the engine jackets and over the tower.

The plant is being paid for out of earnings, for the net profits after deducting depreciation on building, machinery and distribution line were $22,000 in 1928, and with the larger motor load of this year the net profits should be increased, even though the electrical energy for motors is sold at 2c. per kilowatt-hour.

The secret of this plant's success is chiefly in the care given the machinery, which is maintained in the best of condition.



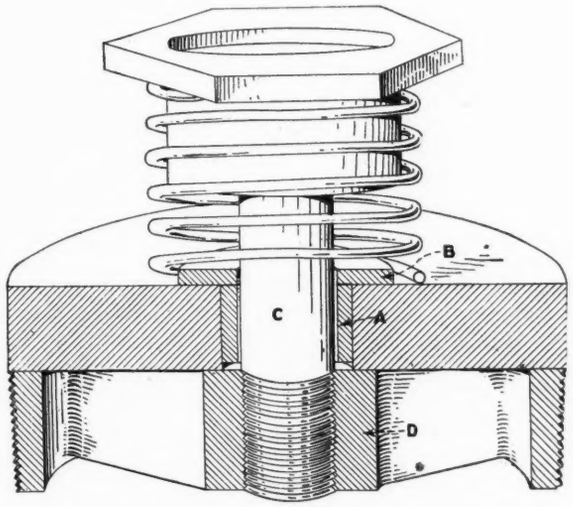
The two Fairbanks, Morse & Company Diesels in the Higginsville light plant

Right Out of the Plant

Pump Valve Disk Repair

NOT infrequently the center hole in a hard-rubber pump valve gets enlarged sufficiently to allow considerable water to leak by the stud. This is usually repaired by reaming out an enlarged hole in the disk and using a piece of brass tube over the stud to fit the enlarged hole. This serves all right for a time, but the hole soon becomes worn again.

A repair that has been used with good results is illustrated. The worn hole is reamed out and a short piece of brass tube *A* is used for a bushing, and a brass



Valve disk with brass bushing in center hole

washer *B* is soldered to it to form a shoulder. The hole in the tube should, of course, be an easy fit over the stud *C*.

All the wear will now come on the tube and stud, and the hole will remain in good condition much longer than before. If the washer used is of sufficient diameter, four holes can be drilled near the outer edge and wood screws used to secure it to the disk. This will not be necessary if the tube is made a tight driving fit in the disk. When the face of the disk becomes badly worn and is of no further use, the brass tube and washer can be removed and put in another disk.

Toronto, Ont. J. E. NOBLE.

What About Furnace Volume?

HOW does the average furnace volume per unit of boiler output of today compare with that of three or four years ago? How does the cost per cubic foot vary? Is it possible to evaluate the various costs, so as to balance the higher cost of the larger furnace volume against the lower fuel consumption, due to higher combustion efficiency? First cost is tangible, whereas estimated over-all efficiency is largely hypothetical—and while the contractor is endeavoring to meet the price, the stoker man is striving for a more expensive furnace. Hence, furnace volume is too often a compromise wherein the possible higher over-all efficiency is sacrificed for the lower, certain, first cost.

Too often the executive who must make the decision is between several crossfires. The contractor who is to build the furnace, fearful of losing the job, submits a low price and suggests a furnace which he knows is not as large as it should be but which he hopes will "get by." The boiler manufacturer and stoker builder, on the other hand clamor for larger furnace volume that their equipment may show up to better advantage, their savings ultimately counteracting the higher first cost. What weight of evidence can the boiler manufacturer throw into the scales, facts instead of theory? Recognizing that the trend is for larger furnace volume, what has actually been done in terms of "cubic feet of furnace volume per square foot of heating surface" for various sizes of boilers? How does the cost vary? What estimated savings can be offered as inducement for greater furnace volume?

How much easier it would be if one could put his finger upon a curve and say "here is the cost of so many cubic feet, and the over-all efficiency will be so-and-so. Here is the cost of so many more cubic feet, where combustion will be smokeless, where fuel savings will be such that the higher first cost will be more than counter-balanced within twelve months. This curve over here shows standard first-class practice of two years ago. Here is a conservative estimate on savings due to the greater furnace volume. Note how little the additional cost per cubic foot really is. It will be paid off within a year, without capitalizing the longer furnace life and the ability to operate at higher combustion rates when required."

The fundamental formula for smoke prevention is well known, namely, time, temperature, mixture, air. These are the "big four." Each must be satisfied if smoke prevention is to accrue and if efficiency is to be high. Where smoke occurs or where it is impossible to obtain overload capacity, one of these factors is not satisfied.

Whether it is a condition of flame travel, carbon dioxide, refractory deterioration, temperature, furnace height, width or depth, it is furnace volume which provides the time and the space for adequate mixing of oxygen and fuel, for ignition and combustion. Granted that furnace volume is the crux of the situation, what factor usually determines the volume? If many installation are any criterion, first cost is the deciding factor. Yet it should be ultimately and basically the B.t.u. liberated per hour. A rule-of-thumb method of calculating furnace volume is to provide 1 cu.ft. of furnace space for each 15 lb. of steam delivered by the boiler. Such a rule is unscientific and unsound, of course, and holds only for a coal having a definite heat content. The use of this rule is a prolific cause of smoke. It explains why one installation will smoke while other installations of identical design are free from smoke.

Many central station companies are employing 1 cu.ft. of furnace volume to every 18,000 to 20,000 B.t.u. liberated per hour. In contrast, the majority of industrial plants use a volume of 1 cu.ft. for every 60,000 to

80,000 B.t.u. liberated per hour. Of course, the furnaces in industrial plants cost much less than those of the central stations. They are much more expensive to operate because they smoke, waste fuel and are unable to develop high combustion rates when required. Their refractories deteriorate rapidly. They cannot use as cheap coal as they otherwise might, and are unable to stay in service as long as they otherwise could.

If the only way to design a furnace is to know the fuel to be used, the heat content and the maximum amount of heat to be liberated or developed per hour, then it is necessary to know the fuel that it is planned to burn. Yet, how often is this known? Furnace volume should be based upon the B.t.u. liberated per cubic foot of furnace space per hour, calculated for the highest combustion rate that will be developed at a hypothetical efficiency.

There are over 20,000 boiler plants in this country with an average steam output of 40,000 lb. per hour, and over 42,000 plants averaging around 4,000 lb. of steam an hour. Surely there is already material among those 20,000 power plants to provide a true cross-section of the trends in furnace design—something specific as to the furnace volume per unit of boiler output.

The industrial executive interested in his power plant, striving to prevent smoke and save fuel, desirous of giving his stoker, boiler and engineer a square deal, who is accustomed to think before he acts demands facts—specific information, not generalities—that he may reason intelligently, act justly and decide correctly; while the boiler setter, boiler builder and stoker manufacturer play their tug-o'-war in the eternal battle of first cost vs. ultimate economy. Who can provide the facts—a true cross-section of what has been accomplished—what furnace volumes are best for various types of stoker, coals, over-all efficiencies, overloads and load factors for different boiler capacities?

W. L. KENT.

Chicago, Ill.

What Causes Air-Receiver Explosions?

AFTER reading the article by C. O. Sandstrom in the Sept. 10 number of *Power* on "What Causes Air-Receiver Explosions?" I should like to point out that his theory in reference to the effect of a leaky discharge valve is contrary to thermodynamics, and also to actual facts. Mr. Sandstrom's deductions in thermodynamics would apply in a case where a trapped volume of air was expanded against the piston doing work. In such a case the temperature would naturally drop, due to the fact that by doing work internal energy was being removed, with the resultant drop in temperature. This is not the case, however, with an air compressor having a leaky discharge valve, where the air from the high-pressure side is more or less throttled through an opening and the work is probably largely done on the air itself, so that little or no refrigerative effect results. It is a well-known fact that if the air is expanded through a valve where the pressure energy is converted to velocity energy there may be a local reduction in temperature, but when the air is compressed again it is heated up.

Furthermore, Mr. Sandstrom neglects the fact that with a leaky discharge valve, the leakage can occur all during the time the pressure in the cylinder is less than the discharge pressure. In other words, the leak can occur all through the suction stroke and on the compression stroke until the point is reached where the pressure inside the cylinder and outside the cylinder balance. It is therefore quite evident that an appreciable amount of hot air can leak back into the cylinder, gradually raising the temperature of the piston, cylinder walls, etc. This, in turn, would raise the temperature of the fresh air taken into the cylinder, and the combined effect is accumulative, so that the discharge temperature would gradually rise.

If he still doubts the foregoing thermodynamics, he can easily check it by arranging to run a compressor with an adjustable leakage provided from the high-temperature side back to the cylinder, using an indicator connection or some other convenient opening with a needle valve in it to regulate the amount of leakage. If he runs without any leakage and arrives at a normal discharge temperature and then allows some of the warm air to leak back into the cylinder, he will note a gradual increase in the discharge temperature.

Flushing, N. Y. P. A. BAUMEISTER.

The Young Engineer and the Boiler Room

WRITING in the September 17 issue of *Power*, Prof. C. H. Berry of the Harvard Engineering School brings out some very interesting and important points concerning power engineering.

Many power companies conduct training courses for technical graduates along the very lines mentioned by Professor Berry, realizing that the technical operating engineer must have a thorough-going, first-hand knowledge of the plant and equipment he is operating. The author is enrolled in a three-year cadet training course in power engineering, the first year of which is spent in the generation department. The schedule of work is carefully planned and rigidly carried out, and includes working experience in the boiler room, turbine room, and switchboard, the technical department, office, machine shop, yard, electrical inspection and repair gangs, load dispatcher's office and some special work with the load-schedule engineer.

The cadet is treated as one of the men, taking part in boiler repair and maintenance, operation of boilers, turbines and auxiliaries, tests on all station equipment, etc., and is given every opportunity to ask questions and acquire information. He also works all the regular shifts in each department of the plant, punches the time clocks, eats with the men in the plant cafeteria, enjoys membership in the station athletic association, and attends the plant social functions. Altogether, the course offers a most excellent opportunity for training the young engineer along the broadest and most comprehensive lines.

An important part of the young engineer's training is an intimate knowledge of his fellow workers. The best way to understand their thoughts and lives is to meet them on common ground—adjusting safety valves on the steam drums, cleaning wind boxes on the midnight watch, or over a cup of coffee in the control room in the early morning hours. He is one of the men, sharing their thoughts, learning their attitudes toward the management.

Having completed this year in the generation department, I can agree whole-heartedly with Professor Berry that the only way to learn power engineering is to get out and do it. The young man fresh from the heights of

senior year may be excused if, at the very first, his blind confidence leads him to believe himself capable of attaining the white collar immediately. But unless he very soon realizes that his college education is a mere beginning, a foundation for the structure of an engineering career, he is not headed in the right direction. Without some practical knowledge the college-trained engineer lacks vital force. The stigma that may attach to a white collar and to a college degree is seldom found on the man who has trod the road of practical experience.

Newark, N. J. WALTER W. SLOCUM.

Water Predictions by Lag of Stream Flow Against Rainfall

THE suggestion to use the lag of stream flow against rainfall made by T. Maretsky in the Sept. 3 issue of *Power,* appears to have meritorious possibilities. It certainly would be advisable to add this method to the others used in the investigation of future runoff. It has recently been investigated in this country by J. W. Shuman, the Power Engineering Company, Minneapolis ("Correlation Between Rainfall and Runoff," J. W. Shuman, M. A.S.C.E., "Monthly Weather Review," May, 1929, Washington, D. C.).

A closer investigation develops numerous difficulties with this method. It is found that the lag is not a constant quantity. After a series of dry years ground storage is depleted, and rainfall is used to greater extent to replenish this storage. After a series of wet years ground storage is full and rainfall runs off faster. The quantitative estimate of runoff from rain thus becomes difficult. Mr. Maretsky refers to exclusion of spring runoff and snowfall in the computations. It is obviously difficult to know just what part to retain and what part to add to the retarded runoff to arrive at nearly a correct result.

The aim is not only a qualitative estimate but also a quantitative one, and that preferably within a limit of, say, 5 per cent. It will be difficult to attain this by the proposed method alone. A high correlation coefficient is not necessarily significant for this purpose. Shuman obtained a correlation of 0.91 for the Tennessee River, but the individual years varied from minus 14 per cent to plus 15 per cent, or a range of 29 per cent. Obviously, this would not admit a close forecast of the expected runoff.

Mr. Maretsky has furnished interesting evidence for the general occurrence of the double Wolf cycle in the Dnieper watershed. The cycle is not used by me numerically, but merely to indicate the trend (see "Notes on Estimating Runoff," Monthly Weather Review, March, 1928). As such its future is sufficiently well known. The inaccuracy of the figures of Kimura as published in the *Astro-Physical Journal,* which Mr. Maretsky refers to, is principally due to the method of analysis used. Lately Dr. Charles G. Abbott and Dr. Clements (see "Report of the Conferences on Cycles," Carnegie Institute, Washington D. C., 1929) have found a close recurrence of the so-called polarity cycle in 22.6 years, if figured from minimum to minimum. My estimates, however, take into account only the trend of the Wolf numbers, and are based on extrapolation of sequences that have been established over long periods.

A. STREIF,

Jackson, Mich. Office of Steven & Wood, Inc.

Selective Interlocking of Motors for Group Operation

SOME time ago a rock-crushing and conveying plant consisting of six motors and one magnetic separator was being installed, and a rather interesting problem in interlocking of motor control circuits was encountered. Briefly, the desired method of operation was as follows:

1. To arrange the entire six motors for sequence operation. (In this case motors, 1, 2, 3, 4, 5, and 6 were to be started in that order.)

2. To arrange four motors in two independent groups of two each. The first group, motors 1 and 2, and the second group, motors 5 and 6, for sequence operation. In this case either or both groups could be started and operated independently of the other.

The selective feature of this control system consists of a two-pole double-throw switch *S,* with one position marked "all" and the other "2 group."

By reference to the wiring diagram it will be noted that if the selector switch *S* is on "all" position, the motors will start in sequence, beginning with motor No. 1, 2, etc. Should any motor fail, all motors connected back of it will immediately stop. For example: Failure

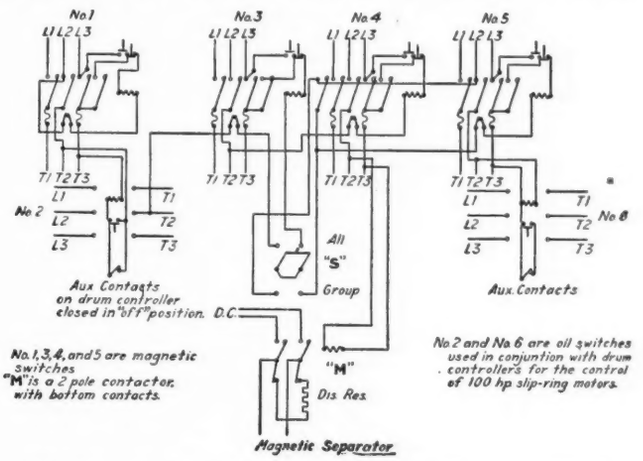

No 1
No 3
No 4
No 5
L1 L2 L3
T1 T2 T3
No 2
No 6
All "S" Group
"M"
Dis. Res.
D.C.
Aux. Contacts on drum controller closed in "off" position.
Aux. Contacts
No. 1, 3, 4, and 5 are magnetic switches "M" is a 2 pole contactor, with bottom contacts.
No 2 and No 6 are oil switches used in conjuntion with drum controllers for the control of 100 hp slip-ring motors.
Magnetic Separator

Diagram of connections for interlocked operation of six motors in sequence or grouped

of motor No. 1 would cause motors Nos. 2, 3, 4, 5 and 6 to stop. Failure of motor No. 5 would cause No. 6 only to stop, and so on. When the selector switch *S* is thrown to "group" position only four motors (in groups of two) can be operated, as follows:

Motors 6 and 5, or 1 and 2, will be interlocked independent of each other. That is, failure of motor No. 1 would affect No. 2 only. Likewise, failure of No. 5 would affect No. 6 only.

It will be seen also that with the selector switch *S* thrown to "group" position the coil circuit of motor No. 3 is opened. This makes improper starting of motors 3 and 4 impossible, as was desired.

This installation has given excellent service, and it is practically fool-proof from an operating standpoint.

H. V. MCCOY,

Buffalo, N. Y. Federal Portland Cement Co., Inc.

One of the best ways of keeping a check on the operation of the non-return valve on each boiler in a plant is to log the time required for the pressure to fall below that of the main header each time a boiler is taken out of service.

What's New in Plant Equipment

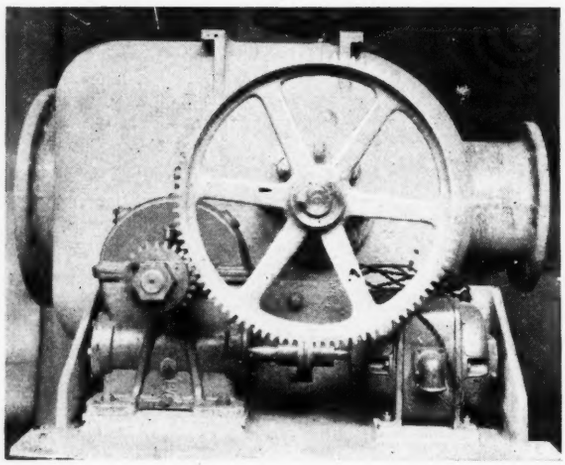
HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Strainer With Motor Drive on Screen-Cleaning Mechanism

FOR a strainer designed for use on suction lines to pumps, condenser intakes, etc., to be adaptable to all classes of service, it is essential that some provision be made for cleaning the screen without taking the strainer out of service or interrupting the flow through the line in which it is used. This has been done in a number of different ways.

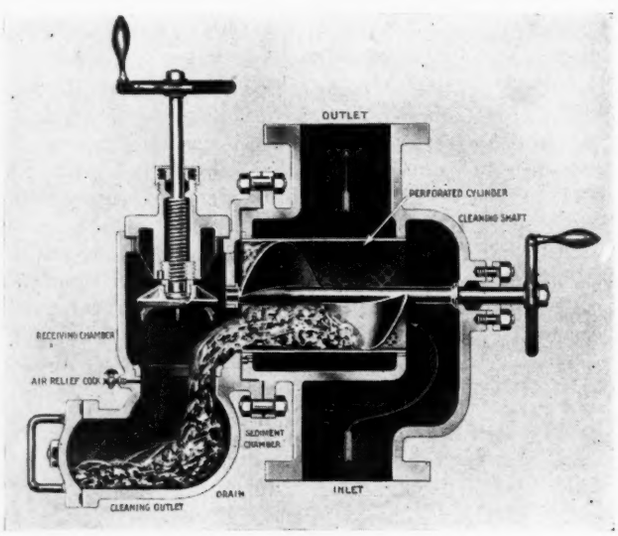
In the Holt strainer illustrated an extra-heavy perforated copper cylinder, having open ends, is interposed between the inlet and outlet, the foreign matter being retained on the inner surface of the cylinder. This surface is cleaned at intervals by rotating a shaft to which is affixed a spiral scraper, as shown in the sectional view. This scraper sweeps the surface of the perforated cylinder, and discharges the refuse through a valve into a sediment chamber. By closing the valve, the sediment chamber is shut off from the strainer body. The refuse can then be removed without interfering with the flow through the strainer.

A recent innovation to this line of strainers, which has been made for some years by the Rosedale Foundry & Machine Company, Pittsburgh, Pa., is the introduction of a motor-operated unit. This makes the larger-size strainer particularly adaptable to bad water conditions, where the cleaning must be done frequently, and to installations where the strainer must necessarily be placed in a rather remote location.



Large strainer with motor drive on cleaning shaft

The motor is connected with the cleaning shaft through a spur- or worm-gear reduction unit or a combination of both. The motor-driven units are provided with large sediment chambers to allow the strainer to operate for several days without cleaning. These units are also made with and without valves for closing off the sediment chamber from the strainer body. A safety shear pin mechanism is incorporated in the drive to protect the cleaning shaft against damage. The drive can be furnished on all strainers 8 in. and larger.

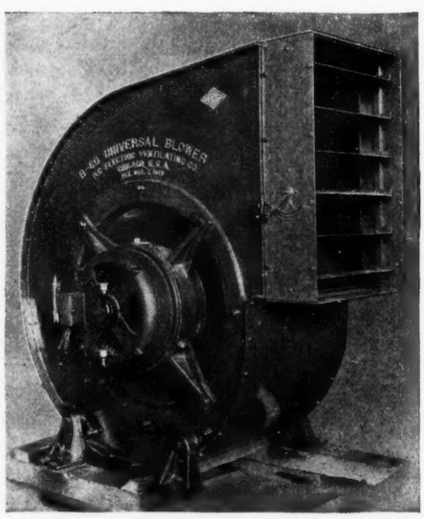


Cross-section of standard strainer

Variable Air Controller

TO PROVIDE variable air control without the use of variable-speed or slip-ring motor to drive the blower the Ilg Electric Ventilating Company, 2841 North Crawford Ave., Chicago, Ill., has brought out a blower with a louvered damper.

The blower is designed for direct connection to constant-speed motors,



Blower with louvered damper

the necessary control of the air being done by limiting the air discharge rather than by varying the speed of the motor. The damper opening is regulated from a quadrant control handle or from the side of the blower housing. Units are also available with the damper arranged for remote control and time-switch operation.

Ventilating Fan Designed for Quiet Operation

ONE of the essential characteristics of a ventilating fan is that it run quietly. This necessitates certain refinements in design to reduce the audible noise to a minimum.

In the new fan, designated Silex, put out by the Buffalo Forge Company, Buffalo, N. Y., the housing is a rolled-up evasé stack designed to convert the air velocity leaving the rotor into static pressure. The discharge cone is carried out beyond the casing to improve the conversion efficiency and to provide a quiet, streamline fan cutoff.

The rotor of the fan has double curved blades, with their tip or outer edge inclined backward and away from the direction of rotation, as shown in Fig. 1. This form of blade

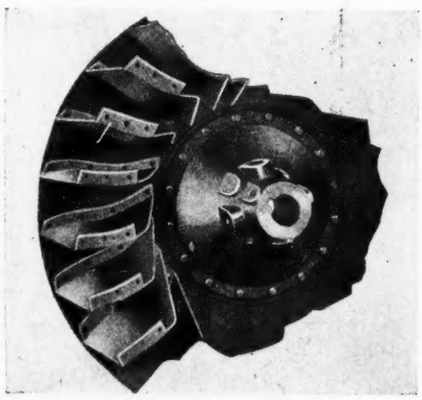


Fig. 1—Section of rotor showing blade design

in addition to giving a lower air velocity at the tip, resulting in quiet operation, gives a rigid blade and strong wheel construction. This design also gives a rising pressure characteristic and a comparatively flat horsepower curve.

The bearings used on the fans are of the self-aligning ring-oiled babbitted type. The split inner babbitted sleeve is held between spherical surfaces, and felt rings are fitted at each end of the housing to exclude dust and prevent oil creep along the shaft.

In the large size, direct-connected unit a flexible coupling of the rubber-bushed pin type is used. In the smaller-sized fans, Nos. 2 to 5, a universal reversible type of housing construction is used. This allows the discharge to be placed in any direction and for clockwise or counter-clockwise rotation. They can also be furnished with double-width housing and rotor, suitable for installation

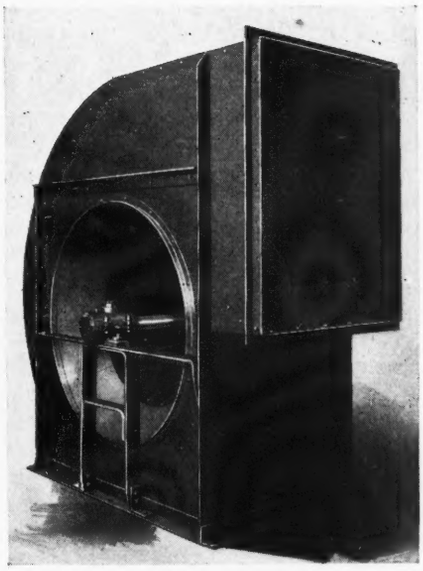


Fig. 2—Silex conoidal single width fan

where the headroom is limited. Single-width fans are available in capacities from 875 to 200,000 cu.ft. of air per minute.

Six-Cylinder Engine-Driven Portable Arc Welder

A NEW portable electric arc-welding machine announced recently by the General Electric Company, Schenectady, N. Y., is driven by a six-cylinder gas engine, and replaces the four-cylinder engine-driven unit previously included in that company's line. The new engine is a $3\frac{3}{8}$x$4\frac{1}{2}$ in. Buda model HS-6 unit built especially for industrial service. The S.A.E. horsepower rating is 27.3, and the brake horsepower is 39 at 1,440 r.p.m. The engine is totally inclosed in a sheet-metal housing.

The engine is equipped with a centrifugal-type air cleaner, high-tension magneto with impulse starter coupling, and speed-regulating governor, in addition to the standard fittings.

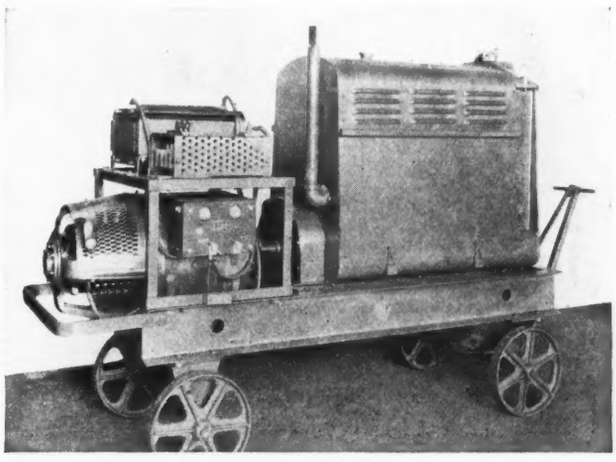
The generator is a ball-bearing, self-excited single-operator machine rated at 300 amp., with a current range of 90 to 375 amp. Included with the set is a current-reducing resistor by which welding currents down to 25 amp. may be obtained, the current being adjusted simply by turning the brush-shifting handle. When operating so that the potential at the generator panel, including reactor drop, is 25 volts, any value of current can be obtained between 25 and 400 amp. A self-adjusting stabilizing reactor automatically steadies the arc, the automatic regulation being obtained by specially designed magnetic circuit without any moving parts.

The complete outfit is mounted on a welded structural-steel base and may be made portable by the addition of running gear, as illustrated. Where used for outside work, a canopy can be provided to protect the generator from the weather.

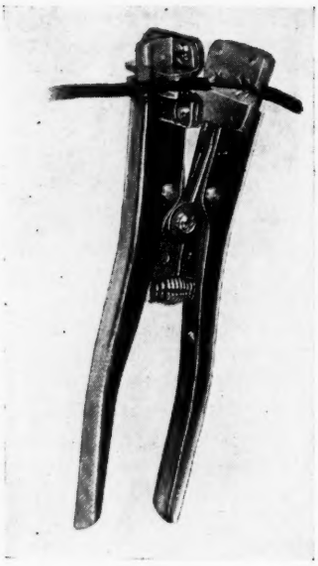
Stripper for Solid Core or Stranded Wire

DESIGNED to protect the operator's hands as well as the wire, the wire stripper illustrated, clamps, cuts and strips the wire automatically with one squeeze of the handle. The cutting edges are shielded, and the blind centers of the notches on the blades prevent cutting or scarring of the wire. The standard model of the tool strips from Nos. 10 to 20 gage solid core or stranded wire, and can be converted to handle larger sizes.

The tool, which is put out by the Ideal Commutator Dresser Company,



Electric-arc welder driven by a six-cylinder gas engine



Tool clamps, cuts and strips insulation in one operation

Sycamore, Ill., is claimed to greatly facilitate the work of cleaning wire, with the added feature that it protects the wire at the end of the strip against nicks and consequent breakage.

Smoke Indicator for Stationary and Marine Boilers

SMOKE abatement campaigns now being carried on in many centers have necessitated firemen or stoker operators keeping a closer watch on the quality of the smoke emitted by their stacks than they would otherwise do except in the interest of economy.

These demands for less smoke have brought about a need for a simple and convenient method of observing the quality of the smoke leaving each boiler before it enters the main breeching or the stack. A device for this purpose and one particularly well adapted for boilers in office buildings, power and industrial plants is illustrated, a cross-section of the indicator assembly and typical installation on a cross-drum boiler being shown.

It consists of a specially constructed lamp unit which projects a ray of light across the gas passage to a second, or "reflecting," unit. From the latter the light ray is reflected to an extension vision box (which is located at the front or side of the boiler, depending upon the type) so that the operator can readily observe the smoke image by means of the indicator from the operating floor.

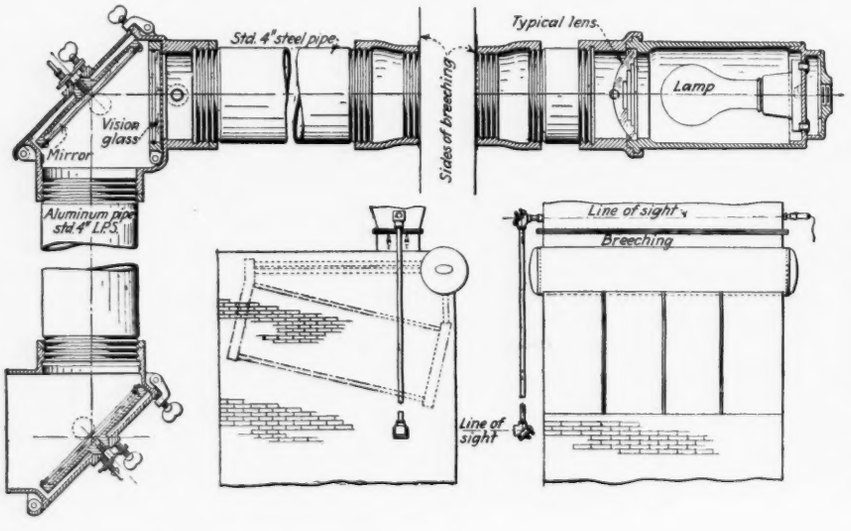
The lamp and reflecting unit have been specially designed to withstand flue gas temperatures and the corrosive effects of the gas and to take care of expansion and contraction due to fairly wide fluctuations in temperature.

In the accompanying illustration are shown the principal parts and assembly of the indicator, and the method of applying it to a cross-drum boiler is indicated.

The indicator, although developed primarily for use with marine boilers and used for some time in that service, is adaptable to practically any type of steam boiler and may be used for oil, or with coal in hand-, stoker- or pulverized coal-fired furnaces.

It is claimed by the manufacturer, the Wager Furnace Bridgewall Company, Jersey City, N. J., that the colors of smoke from zero, or clear, to the very blackest are readily distinguished with the indicator.

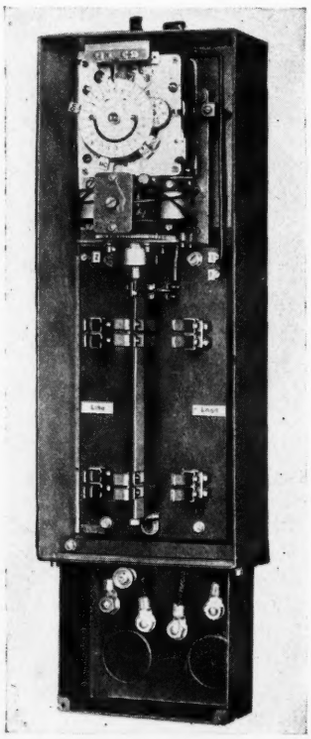
Assembly of indicator and typical installation on cross-drum boiler



Self-Winding Time Switch for Circuit Control

IN THE "Sauter" single-throw self-winding time switch illustrated, used to turn "on" and "off" blowers, ventilators and other electrical circuits that can be operated on a predetermined time basis, the main switch is motor-operated, air-break, rotary and self-winding. The motor is of the universal series-wound type, with jumper arrangement on the field coils to permit operation on 115 and 230 volt direct current or alternating current of any frequency. The clock has a four-day mainspring, but is rewound automatically twice every 24 hours.

The clock can be furnished with a Sunday cutout, automatically causing



Time switch with cover removed

the switch to suspend its functions every seventh day. A single 24-hour dial serves both for time setting and for program setting. Where it is desired to have the operations conform to a constant schedule the plain dial is used. For lighting circuits on all-night or part-night schedule the astronomic dial is recommended, as it automatically resets the daily operations to conform to local sun time, to dusk or to dawn, or to both. The switch is distributed by R. W. Cramer & Company, Inc., 136 Liberty St., New York City.

Welded Steel Boiler Explosion Analyzed

Chief inspector's report shows that local ordinance was disregarded

ON JUNE 26 a low-pressure welded steel boiler serving an apartment house building in Detroit exploded, causing the death of Mrs. Charlotte Adams, a resident, and creating the damage indicated in the accompanying photograph. From a recent report of the accident made by J. C. McCabe, chief inspector of boilers in the State of Michigan, the following details and analysis of the cause are available.

The boiler had been installed in the fall of 1926, without notice to the Department of Buildings and Safety Engineering, so that it had been in operation over two years in violation of the local ordinance regulating steam boilers and their use. It had about 350 sq.ft. of heating surface and should have been inspected annually and operated by a licensed operator.

To avoid the use of stays the firebox was of special form designed as a beam. All of the plate was $\frac{5}{16}$-in. thick. The side, or wrapper, plate and furnace were supported by wrought-iron welded staybolts on nine-inch pitch. These staybolts were made from three-quarter-inch round stock.

The 2½-in. A.S.M.E. code safety valve was not attached to the boiler in an approved manner as the opening in the boiler had been reduced to 1½ in. and the 2½-in. valve attached by means of a reducing fitting. The valve was broken off by the failure, but showed no indications of an overload.

An automatic underfeed stoker fired the boiler. During the heating season it was operated under a partial vacuum for heating the 81 apartments in the building. In the summer it was used at times for heating hot water and it was in operation for this service at the time of the failure.

The initial failure occurred in a staybolt in the second horizontal row from the bottom on the left side and the sixth vertical row from the front, the bolt failing at the end in the furnace plate. Inspection disclosed that the staybolt end in the furnace had leaked for an extended period, as there was well defined corrosion on the water side of the plate from the inleak of air at the bolt end. The weld appeared defective, as part of it had been burned.

Observation of the furnace walls gave unmistakable evidence of overpressure. The top of the furnace had dropped about 1¼ in. in two places. The sides of the furnace were badly deformed from the internal pressure, and deflections between the staybolts of the wrapper plate, which was about 7½x12½ ft., indicated overpressure. These deflections, however, could have been made by the successive failure of the staybolts. This action would throw increasing areas on the stays and give the appearance of overpressure. The fusible plug was not melted. From the bulging between stays, it was estimated that a pressure of over 100 lb. was on the boiler at the time of failure.

The boiler was installed about three feet from the south wall in the basement, the initial failure being on the wall side. The force of the steam acting between the boiler and the wall threw the boiler against another boiler of the same size and make, and threw it about fifteen feet. As the wrapper plate was torn off it unfolded and struck the floor above, on which Mrs. Adams was standing. The wreck of the floor pushed out the south wall, and Mrs. Adams fell into the basement.

Result of low-pressure welded steel boiler explosion

Summary of Inspector's Report

Mr. McCabe lists the following facts as contributing to the failure:

1. Welding of the staybolts was defective in that they were "burnt" in spots.
2. Welding of the boiler plates did not conform with H-78 of the A.S.M.E. boiler code. The plates were offset and the mill oxide had not been removed from the plate before welding.
3. The boilers were installed and used for over two years without approval and inspection by the Department of Buildings and Safety Engineering.
4. The boiler was operated without a licensed operator.
5. The accident shows conclusively that a welded staybolt as provided for in the boiler code is not dependable.

It was his opinion that the code should be revised to provide that only mild steel be used for staybolts, that the bolt be made to project at least an amount equal to its diameter, that the mill oxide should be removed before welding, and that the end be headed down after the welding. Tests had shown that an iron stay would fail under less loading than a mild steel stay when welded as provided by the code, and that when headed the full strength of the steel would be developed and a failure like the foregoing would be impossible in a welded staybolt boiler. The tests referred to give the following results:

Wrought-iron stay, ¾-in., 9-in. pitch; load to induce failure, 9,070 lb.; deflection or set of plate $\frac{7}{16}$ inches.

Mild steel stay, ¾ in., 9 in. pitch; load to induce failure, 9,515 lb.; deflection, $\frac{9}{16}$ inches.

Mild steel stay, bolt headed, ¾ in., 9 in. pitch; load 20,000 lb., with no evidence of failure; deflection, or set, ¾ in. This load did not reach the yield point of the metal in the stay within 8,000 to 10,000 lb. It would take a pressure of 250 lb. to give the load of 20,000 pounds.

These tests indicated the weakness of the code requirements. To avoid the repetition of failures similar to the one under description it was Mr. McCabe's suggestion that the code provision for welded staybolts should be revised as previously outlined.

FROM AMONG READERS' PROBLEMS

Conducted by L. H. MORRISON

WATER DISAPPEARS FROM GAGE GLASS—*What causes water to disappear from the glass of a water-tube boiler for a few minutes and then show up again?* R. S.

If the boiler is being forced, rapid steam generation in the bottom tubes empties these tubes of water, and immediately the release of the steam up the header permits the water to flood the tubes, which results in a lowering of the water level in the glass. This happens seldom, only when the rear circulation connections are badly sealed up.

SENSIBLE AND LATENT HEAT—*What is the difference between sensible and latent heat?* H. G. K.

If, when we add heat to a substance, say, water, the temperature rises in direct ratio to the heat added, we say we are adding sensible heat. If the heat added is used to change the water into steam, no change in temperature occurs during evaporation, and we say latent heat has been added, that is, the heat addition cannot be detected with a thermometer.

WATER-COOLED FURNACE WALLS—*How does one calculate the amount of heat absorbed by the water walls of a furnace?* C. A.

The process by which the exact amount of heat absorbed is calculated involves computations and cannot be published on this page. Professor Wohlenberg's paper on the subject may be found in the A.S.M.E. transactions.

A practical figure to use is 40,000 B.t.u. per hour per square foot of pipe surface.

CALCULATING THE EFFICIENCY OF LIGAMENTS BETWEEN TUBES—*Do you use the diagonal distance between staggered tubes in figuring the ligament efficiency?* C. C. M.

The proper ligament to use depends upon the relative diagonal and longitudinal distances between the tubes. The A.S.M.E. Boiler Code gives a chart by means of which the efficiency can be determined.

INTERMEDIATE PRESSURE OF AN AIR COMPRESSOR—*If a compound air compressor is operating with a head pressure of 120 lb., will the intercooler pressure change when the discharge pressure drops to 90 lb.?* M. D.

The intercooler pressure depends upon the volume ratios of the high- and low-pressure cylinders, and is established when the machine is designed. A change in discharge pressure does not alter the volume ratios, and so does not alter the intercooler pressure. However, if the clearance volume of the high-pressure is large, the variation in the re-expanded volumes of the clearance air would somewhat alter the intercooler pressure.

PREVIOUS QUESTION

DISCUSSED BY READERS

THE QUESTION

WE PLAN to install unit pulverizers with our 3,000-sq.ft. boilers. It is necessary to carry a light load at night. Will this be possible with a single burner per boiler installation? C. C. M.

OUR plant is equipped with four attrition pulverizers, air-cooled walls, and three 3,000-sq.ft. boilers of the bent-tube design, with a single horizontal turbulent burner per boiler, burning bituminous coal.

A fourth pulverizer is interconnected and arranged to feed any of the boilers in case of emergency.

It is quite possible that some have experienced considerable difficulty with burners put out in conjunction with pulverizing equipment in that they are more or less dependent upon an extremely limited number of types of bituminous coal which they can burn successfully without undue maintenance on the furnace walls.

For instance, a high-volatile coal will conceivably ignite quicker after entering the furnace and develop a flame the major portion of which will be concentrated at the front end of the furnace, with detrimental action to the arch and the extreme end of the burner itself. It is furthermore conceivable that with a low-volatile coal, a flame of very different character would be obtained, that is, one that would be longer, due to the relatively slower ignition, compared with the higher-volatile coal.

The same limitations perhaps would be experienced by us with our horizontal-fired turbulent burners were it not for the fact that we have positive control over the shape of the flame. We can control this in two distinct manners. First, we alter the angle of the vanes at the end of the coal-discharge pipe, which, of course, causes a long or short flame, depending upon the bituminous coal used. This adjustment is more or less permanent and is made at the time the type of coal to be burned is known, that is, during the starting-up period.

Along with this we have means of adjusting the position of these vanes. This control, located on the outside of the burner, consists of vanes moving in or out of the coal-discharge pipe.

The second control consists of air baffles in the secondary-air housing surrounding the coal-discharge pipe. By altering the position of these the pressure of the air admitted to the furnace can be readily controlled. This is positive over the character of the flame as regards length and general appearance, which we designate as "fat" or "lean."

We have another means of adjusting the secondary-air quantity, which consists of setting the ganged dampers in the secondary-air supply line itself.

Whether the coal be low or high volatile, we have a sufficient control over the flame, by an adjustment readily made from the front of the furnace, to meet any load or furnace condition.

P. DIAS,
Plant Engineer,
Essex County Hall of Records
Newark, N. J.

THIS question is one that can definitely be determined only when the meaning of "light load" is known. That term in one installation may mean far different than in another.

Assuming that 3,000-sq.ft. boilers means a small central station tied in with a network or in parallel with hydro plants, or an industrial plant where the design of furnace and equipment is such as to allow a rating of not to exceed 200 per cent it would be possible to operate at a minimum rating of 20 per cent by careful control of air and fuel to a single burner. The burner, however, should be of the type for horizontal flame projection, and the

furnace walls should be refractory-lined rather than water-cooled, or at least should be a combination to give a low percentage of the latter, to keep up temperature in the furnace at the low rating desired and operate economically. Heated secondary air would be advisable to quicken the combustion at the burner outlet, but not too hot to shorten the burner's life.

The kind of coal and the moisture content would influence minimum rating to some extent. The success of such an installation is mainly dependent on burner selection.

V. E. Todd,
Wisconsin Power & Light Co.
Sheboygan, Wis.

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IT IS doubtful if it would be possible to carry a light load at night with a single burner on a 3,000-sq.ft. boiler. It is hard to say just what can and what cannot be done, as so much depends upon the size and type of furnace used, and upon the quality of fuel burned.

With a well-designed setting and a good grade of fuel it might de done, while with a poorly designed furnace or a low-grade fuel it would not be a success. The use of two burners per boiler, one of which would be used to carry the light load, would be a better plan.

I do not think that pulverized coal is to be recommended under these circumstances. An underfeed stoker would be as economical, and be more flexible and reliable at fractional loads, as unit pulverizers. The first cost of such stokers would also be less.

Only when continuous high ratings are maintained should pulverized coal be considered.

Albert E. Pitcher,
Westinghouse Electric & Mfg. Co.
Philadelphia, Pa.

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ASSUMING 200 per cent boiler rating, a pulverizer with 3 tons per hour capacity would be sufficient. If a single burner per boiler is to be used and the load at night is light, then the "unit-bin" system would be the most advantageous. During daytime the pulverized coal can be fed directly to the burner and the surplus stored in a bin placed under the cyclone. At night the pulverized coal can be taken from the bottom of the bin by a feeder and fed to the fan, and from there to the burner. The advantage of the unit-bin system is the low power consumption, for the reason that transport air is utilized as primary air and an additional fan is not required.

It is flexible, as burners can be cut out at will and the load on each burner can be reduced to a minimum. It is clean and requires no vents. Storing the pulverized fuel enables inspection and repairs to the pulverizer without interruption of the service to the burners. With the fan on the suction side of the cyclone, the maintainance is low.

Ignacio Izsak, M. E.
Chicago, Ill.

I THINK it is possible to carry a light load with a single burner under a 3,000-sq.ft. boiler. I see no reason why one cannot carry 40 or 50 per cent of the rated load by decreasing the feed and air on the unit pulverizers, and setting the boiler damper accordingly.

The only trouble one might experience with too light a load is the lowering of the furnace temperature to a point where proper combustion cannot be obtained. This will allow some of the coarse fuel to fall to the bottom of the furnace unburned, forming a slag. In addition, a slag might form on the bottom rows of tubes, depending on the type of boiler.

B. E. Smithers, *Eng.*
Murray Wood Products.
Memphis, Tenn.

A Question for Our Readers

HOW is the power developed by a direct-current motor affected by a drop in line voltage? For example, a 10-hp. 230-volt, 1,750-r.p.m. compound-wound motor is installed in a mine 1½ miles from the power house. The full-load current of the motor is 39 amp. Under test the motor takes 40 amp. at 150 volts. What power is developed by the motor, its efficiency being 86 per cent? With normal voltage a 5-hp. motor would be amply large to handle the load under normal conditions. On account of the voltage conditions, would it be advisable to use a smaller motor?

C.O.L.

Suitable answers from readers will be paid for and published in the Nov. 12 issue.

THE conditions can be met nicely by certain pulverizers and burners, but not by all. Without information regarding coal, also regarding desired maximum and minimum boiler ratings, it is necessary to tell what can be done on an average job.

This size of boiler would probably not justify water-cooled walls except for extremely poor coal. Assuming 25 per cent maximum rating, with plain refractory construction or with hollow air-cooled walls, it should be possible for the same single burner to get down to 25 per cent minimum continuous rating. Were the setting water-cooled it might be found that 40 to 50 per cent of rating would be the practical minimum.

It is not only necessary to pick the right size of burner and pulverizer, but also to make sure that their basic design permits the proper handling of air and coal at these low ratings.

The pulverizer should have a low quantity of primary or carrier air, so that at low ratings it would not be necessary to damper back the carrier air or otherwise interfere with the proper flow of air and coal through the pulverizer, consequently avoiding clogging and essential changes in fineness. It is necessary to select a burner in which the primary air entering with the coal is the smallest possible portion of the total air. Here again the full quantity of primary air may be discharged at low ratings without the necessity of dampering back. Consequently, the velocity of the coal leaving the primary-air nozzle will not be decreased, and the danger of burning back into the nozzle, or even back into the pulverizer, will be avoided. This indicates the use of a so-called "turbulent" burner, where the secondary air is introduced in a different direction from the primary air and mixes with it in an elongated, spiral path. At low ratings the secondary air becomes practically negligible and the burner operates practically on a natural-draft principle.

For a small boiler, it is even possible to use a natural-draft burner without secondary-air equipment. The efficiency involved, however, is noticeably less than when turbulent forced-draft firing is employed. It is also found easier to control the forced-draft installation and to regulate the proper relative quantities of coal and air to maintain high CO_2.

Another important factor in the obtaining of low ratings is to have a tight damper at the boiler outlet, so that the draft in the furnace may be reduced to any desired quantity. This avoids the drawing in of a great deal of excess air, which would tend to put out the flame.

If one will take pains to inquire, when selecting equipment, what minimum quantity of air can be discharged by the pulverizer per minute and what minimum quantity of carrier air can be handled by the burner per minute without loss of satisfactory combustion, he can readily convert this into terms of pounds of coal which can be burned with this quantity of air. By assuming an efficiency of approximately 70 per cent and inserting the value of the coal he can transfer this into pounds of steam evaporated. This figure will represent an absolute minimum based on no secondary air or air leakage whatsoever. Practical results will fall somewhat above this mimimum rating, depending on local conditions.

In the case of larger boilers, if the ten-to-one load range mentioned is not sufficient, there is sometimes inserted in the furnace a small natural-draft burner fed by a branch from the main coal and air pipe. This burner is shut off when the larger forced-draft burner is used. In all events a decision depends on local conditions.

John F. Kyes, Jr.,
Riley Stoker Corporation
Worcester, Mass.

Recent Publications

Popular Research Narratives, Volume III. Collected by the Engineering Foundation. Published by Williams & Wilkins Company, Baltimore, Md. Cloth; 5 x 7½; 174 pages. Price, $1.

A COLLECTION of fifty true stories of research, written in interesting, non-technical style, on subjects all the way from air mapping to cast-iron pipe, from color movies to plant diseases, is contained in this third volume of the "Popular Research Narrative" series. They are not intended to be scientific treatises, but for the non-scientific person, or for the scientific person in fields other than his own, they furnish information, entertainment and the inspiration that comes from learning of the vicissitudes and triumphs of the leaders of the age of science. Several half-tone illustrations of leaders in the field, including Elmer A. Sperry, president of the A.S.M.E., are included in the book.

Electrical Utilities — The Crisis in Public Control. By William E. Mosher and Associates, under the auspices of the School of Citizenship and Public Affairs, Syracuse University. Published by Harper & Brothers, New York, 1929. Cloth; 6 x 9 in.; 334 pages. Price, $4.

AS ELECTRICAL utilities become gathered into fewer and larger groups, through the operations of holding companies and the formation of mergers, sentiment is being built up in certain quarters for a change in regulatory methods. It is held that the regulation of these public service companies by state commissions is no longer adequate to meet the changed conditions and that some scheme similar to that by which railroads are controlled by the Interstate Commerce Commission is necessary to provide proper protection for public interests.

The survey upon which this book is based was conducted in an attempt to determine whether or not a change in utility regulation was advisable. In making it, the writers endeavored to avoid theory and prejudice and to base their conclusions solely upon facts and ascertainable evidence. In spite of this, there will be much disagreement with the conclusions reached and much of the evidence will be disputed. This is to be expected, for public utility affairs are at present undergoing so many radical changes that one man's guess as to the final outcome is as good as the next's.

From the evidence gathered, the authors conclude that regulation of state utilities is at present falling far short of satisfactory performance of its functions. They also find that such operations as the activities of holding companies and many interstate operations are subject to no control. They feel that the country stands at a parting of the ways—one road leading to government regulation in the interest of the public, the other to a minimum of regulation in the interest of controlling stockholders. This is the crisis they mentioned in their title.

In conclusion, they do not look for government ownership to make much headway. What they feel is needed is a more enlightened and public-spirited leadership throughout the industry. Without such leadership, rigid and sweeping federal control is looked for, or even state ownership and operation.

Wärmekraft und Wärmearbeitsmaschinen (Heat Energy and Heat Engines). By A. Loschge. Volume IX, Part 2, Wien-Harms Handbuch der Experimentalphysik. Published by Akademische Verlagsgesellschaft, m.b.h., Leipzig, Germany, 1929. Cloth; 7 x 10 in.; illustrated; 362 pages. Price, $8.65 (36 Rm.).

PRINTED in German, this book is divided into three parts. The first of these deals with the theoretical, thermodynamic side of the subject. Following this are 281 pages devoted to steam engine, steam turbine, boiler, internal combustion engine and gas and oil turbine theory. The third section deals with the theory of compressors and their application in refrigeration.

As would be expected in a series of this nature, the present volume is a theoretical and mathematical treatment of the subject. Its publication is of little moment to the average American operating engineer, but for those designing engineers who read technical German it has value. Particularly impressive is the brevity and clarity of the presentation, qualities too often lacking in theoretical texts of this class.

Industrial Economics. By Dexter S. Kimball, Dean of the College of Engineering, Cornell University. Published by the McGraw-Hill Book Company, New York City. Cloth; 6 x 9 in.; 312 pages; 31 illustrations and plates. Price, $3.

ONE of the series on industrial management assembled by the publisher, in this book the author makes a plea for the adoption of more scientific control of production and sales in industry. As the material is composed in general of lectures given to third-year students in the Cornell engineering courses, the aim and the result is to give a broad view of the economic background of the manufacturing industries; still even high administrative officials should find much of value in it, though the author's views may not always be accepted. Certainly, as Dean Kimball points out, standardization in manufacture is essential, but one example cited, that of the Hog Island fabricated ships, produced during the war, will hardly withstand close scrutiny, for these standardized boats were never a success and the plan has never been adopted by any commercial shipping firm or shipyard. Nor will the average man agree that new inventions are more likely to be made by those whose attentions are confined to a narrow field. Surely the most widely known inventor, Edison, has ever displayed the schoolboy habit of skipping from one field to another without detriment to his productive capacity. The volume goes a long way in upsetting many poular but erroneous ideas as to manufacturing costs and is well worth not only a first but a second reading.

1929 Supplement to the Book of A.S.T.M. Standards, 1927 Edition. Published by American Society for Testing Materials, Philadelphia, 1929. Paper; 6 x 9 in.; 293 pages. Price, $1.50.

THIS is the second supplement to the 1927 Book of A.S.T.M. Standards and contains 51 standards adopted or revised by letter ballot of the society on Sept. 3, 1929. A-57-29, carbon-steel castings for valves, flanges and fittings for high-temperature service; A-106-29, lap-welded and seamless steel pipe for high-temperature service; B-44-29, seamless admiralty condenser tubes and ferrule stock; D-271-29, laboratory sampling and analysis of coal and coke; and D-291-29, test for cubic-foot weight of crushed bituminous coal, are of interest to the power field.

Lubrication—A new 40-page issue of the bulletin on Diesel Engine Lubrication by the Vacuum Oil Company, of New York City, is now available. Those familiar with the long list of technical bulletins issued by this company will appreciate their value and the importance of keeping them on file for reference. This bulletin deals with the evolution of the Diesel engine, its elementary principles, the means for maintaining lubrication, requirements of different types of engines, and recommendations as to the correct oils for various conditions of service. Discussion of the purification of lubricating oil in service and the various methods of purification, as well as operating notes dealing specifically with power and air compressor cylinders and bearings, adds to its practical value.

In View of the Recent Discussion in *Power* centering about the Loeffler "steam-pumping" boiler, many readers will be interested to know that an extensive discussion of the subject is now available in English. An article in German by Prof. Dr. Loeffler appeared in Nos. 39, 42 and 45, volume 72 (1928) of *Zeitschrift des Vereines Deutscher Ingenieure*. The English translation, entitled "The Age of High Pressure Steam," and covering 22 pages, may now be obtained without cost from the Witkowitzer Bergbau-U. Eisenhutten Gewerkschaft, Czechoslovakia.

Third National Fuels Meeting
Held in Philadelphia

Smoke Abatement, Stoker and Water-Wall Construction, Fouling and Low-Temperature Carbonization Are Topics of Discussion

THE Third National Fuels Meeting brought together in Philadelphia last week the foremost fuel engineers in the country, as well as a large number of those to whom the proper selection and combustion of fuel are of vital importance. The gathering, with a foundation of two highly successful meetings in previous years to build upon, rose to new prominence as a technical session and to greater good fellowship as a social reunion.

The meeting opened Monday morning, Oct. 7, when Prof. R. H. Fernald, director of the Department of Mechanical Engineering at the University of Pennsylvania, delivered the opening address on "The Fuel Engineer, His Training and Work." Technical sessions continued through the week until Thursday afternoon. Four inspection trips, a smoker, a banquet, and an interesting program for the ladies were included in the program.

The papers were classed in four groups, with simultaneous sessions covering power, industrial applications, domestic fuels, and general applications. In addition, an all-day session on Thursday was devoted to smoke abatement. Only those papers of particular interest to power men will be reported here.

Following words of welcome by Mayor Mackey, and a response by C. N. Lauer, Dr. R. H. Fernald delivered the opening address.

The United States, said Dr. Fernald, produces nearly one-half the solid fuel and three-fourths the liquid fuel of the world. Moreover, over 90 per cent of the power and heating demand depends upon fuel. Until recently fuel sold itself, and there was little need for the fuel engineer. Now, however, the situation is quite different. Fuel values are an important factor in their utilization, requiring scientic study in their application to power and industrial purposes. What was formerly thrown away is now being put to use. Pulverized coal, smoke abatement and coal processing are a few of the additional problems that have created a demand for the services of the fuels specialist.

At the general session Monday afternoon, Martin Frisch presented a paper discussing relative economy of pulverized coal, oil, and gas as boiler fuels.

Sampling Pulverized Coal

Following Mr. Frisch's paper, Horace C. Porter, fuels engineer, spoke on methods of sampling pulverized coal to determine its fineness. Stressing the growth of the pulverized-coal utilization in the last few years, and the great influence which the fineness of division has upon performance, Mr. Porter went on to say that "in all these applications of powdered coal, higher efficiencies and smoother operation are obtained by having a maximum uniformity in the fineness."

The various methods of sampling used in both the storage system and the unit system were summarized by Mr. Porter. "In the storage systems," he continued, "the pulverized coal may be sampled from the storage bins, the conveyors, or the pipes delivering to the bins, or from the air stream in the pipes between the pulverizer and the cyclone separators, or between the storage bin and the burner. It is best, in sampling from pipes, to use a vertical pipe. In the unit system it can be sampled only in the pipe leading from the blower to burner." The difficulties in sampling from an air stream, in a pipe, according to the speaker, arise from the varying velocity, the varying density of the coal, and the varying fineness of coal over a cross-section of the pipe.

The following precautions were considered by Dr. Porter as essential to securing a good sample.

1. The sample should be taken from a vertical pipe, if taken from the air-coal stream.

2. The sample should be taken at least 10 ft. away from any elbow, branch or irregularity in the line.

3. The sample should be taken as far away as possible from the distributing action of fans or blowers.

4. A stuffing box should be used through which can be moved freely a sampling pipe with a right-angled bend at its inner end, facing the air stream, and without irregularities on its inner surface. This tube should be moved systematically to different positions in the cross-section of the pipe, so as to correspond in its time schedule with the known variations in density of the coal-and-air mixture.

5. Samples should be taken at a number of places in the piping system and be mixed to obtain an average.

It was brought out in the discussion of Doctor Porter's paper that fineness is more important with high-grade high-carbon coal, but that the decreased carbon loss through greater fineness might easily be offset, with some coals, through increased power and maintenance. It was generally conceded that most any degree of fineness could be obtained, according to where the sample is taken; also that samples should not be taken from horizontal pipes; and that one should look out for segregation of slides when taking a sample from the bin spout.

Experience in cement mills had indicated that there was no universal degree of fineness that should be aimed at, but that the degree of fineness depended upon the individual plant.

The third paper presented at the general session Monday afternoon was "Liquefied Petroleum Gases as Industrial Fuels." At the domestic session Samuel S. Wyer spoke on "Some Fundamentals of the Domestic Heating Problem," and Joseph Harrington told of the development of stokers for apartment houses and office buildings.

At the general session, on Tuesday morning, Clarence B. Wisner spoke on "Coal Pretreatment." The plant referred to by Mr. Wisner was described in a paper by W. H. Allen, Jr., at the International Conference on Bituminous Coal at Pittsburgh, Nov. 19, 1928, and was reported in *Power* at that time.

The session on stokers was also held Tuesday morning, H. D. Savage presenting a symposium, "Recent Developments in Mechanical Stoker Design."

At the industrial sessions on Tuesday, the following subjects were among those discussed: "Economics of Industrial Heating Practice," J. A. Doyle; "Electrically Heated Hardening and Tempering Baths Compared With Fuel Methods of Heating," Wirt S. Scott; "Gas for Industrial Purposes," H. O. Loebell; "Oil for Industrial Heating Furnaces," Leod D. Becker.

Low-Temperature Carbonization

At the general session on Wednesday morning Max Toltz described the first completed American installation of the German "Lurgi" process for treating low-grade fuel at Lehigh, N. D. The process is adapted to North Dakota lignite only and produces a carbonized-coal residue which, when bound together with one of the byproducts, pitch, and pressed into briquettes, delivers a smokeless, sootless, clinkerless fuel of high recoverable heat value claimed to compete successfully in the market with anthracite and all intermediate grades of natural and briquetted coal.

The accomplishment has shown, according to Mr. Toltz, that through this new process of chemical change, the vast lignite resources of North and South Dakota and eastern Montana can now be made available for commercial use. Dr. Toltz described the various steps in the carbonization process in detail from the raw lignite to the finished briquettes, which are similar in size and shape to an egg.

"So far as could be ascertained," he said, "the cost of manufacturing a ton of briquettes at the Lehigh plant is a little more than $6, but it is estimated, and quite conservatively, that with an eight-unit plant and a strip mine in which coal can be produced for less than one-half the present cost of operation, one ton of briquettes can be manufactured for $3.30 or less."

J. D. McQuade, of the Coal Carbonization Company, Pittsburgh, Pa., discussed the Hayes process of low-temperature carbonization as installed at Moundsville, W. Va. This development, which was undertaken to provide a means whereby slack coal or screenings, constituting from 30 to 40 per cent of the output, could be changed into a fuel which could be sold at a profit, has proved so successful that the unit will be expanded into a much larger one.

Mr. McQuade predicted that the time cannot be far distant when bituminous coal will not be in general use in its raw state as a fuel, but its place will be taken by a smokeless fuel, the product of low-temperature carbonization of this coal. This change, according to the speaker, would not only put the business of producing bituminous coal on a profitable basis once more, but also would do much toward the solution of the smoke nuisance.

Discussion of the low-temperature carbonization papers was enthusiastic and brought out a number of points that are worth attention at this time in connection with the progress of this process.

Dr. Raymond Soule stated that he considered the Lurgi process well adapted to the carbonization of lignite. However, from experience, he considered the high cost of briquetting a carbonized fuel to be one difficulty in the way of successful commercial application. This cost often exceeds that of all the other processing, and it is there that economies must be effected.

The high cost of carbonizing equipment was discussed. H. W. Brooks stated that whenever the initial investment exceeded $1,500 per ton of daily output, failure would be certain, except in certain special localities where unusual conditions permitted a high selling price for the residual fuel.

The power plant session took place Wednesday morning, when Ollison Craig, consulting engineer for the Riley Stoker Company, spoke on "Some Economic Considerations of Water-Wall Installations." In reality, there is only one reason for the use of water walls in a boiler furnace, according to Mr. Craig, and that is decreased cost of steam production. "Decreased cost of steam production," continued the speaker, "may be realized through greater thermal efficiency, increased capacity, or use of cheaper coal, but certain things that can produce greater efficiency, such as reduced excess air, will result in higher furnace temperature. Greater capacity produced by greater fuel-burning rate can also result in higher furnace temperatures. Cheaper coal may mean lower-grade coal having ash which fuses at a lower temperature. Spending money for water tubes in furnace walls may then result in reduced steam cost by preventing deleterious effects of high furnace temperature and permitting operation either at increased efficiency or at higher capacity or with cheaper coal. The decision in a particular case as to whether water tubes should be installed in the walls of a furnace, and the area of water-tube surface to be installed, depends on the load it is desired to develop, the economical limit of excess air, and the fusion temperature of the ash in the coal. The increase in cost of such tube area must be set up against reduction in cost of boiler and furnace, against the reduction in cost of coal consumed, and against reduced price of coal per ton."

The Third National Fuels Meeting of the A.S.M.E., which was attended by about 900 engineers, at the Bellevue-Stratford Hotel, Philadelphia, last week, under the chairmanship of Victor J. Azbe, served to focus the attention of power engineers upon problems of combustion and furnace design. The fuel problems and experiences of engineers throughout the country were reviewed at the meeting. Those of particular interest are briefly summarized in this article.

Water-Cooled Furnace Design

J. S. Bennett and P. N. Oberholtzer, Philadelphia, Pa., engineers with the American Engineering Company, told of the experiences of one manufacturer in designing and operating water-cooled furnaces, particularly those designed for underfeed stokers. They presented data covering results and conditions of several actual installations.

It was pointed out in the paper that the determination of the proper amount of water cooling is an economic, rather than a combustion, problem. Ordinarily the most critical portion of the furnace is the rear wall, so that if but one wall is to be cooled, it should be the rear wall. Sometimes the sizes of stokers used in older-type plants are limited by the ability of the furnace to withstand temperatures resulting from higher combustion rates. In many such cases a moderate investment in water cooling will give a substantial increase in steam output.

The ever-increasing difficulties of operating modern chain-grate stoker plants on central Illinois coal at high ratings were discussed at this session by J. W. Pierson, boiler room engineer for the Commonwealth Edison Company, Chicago, Ill. According to Mr. Pierson, such a situation is exemplified at the Crawford Avenue station, where fouling has developed into a major problem still far from solution.

The coal burned has many unfavorable characteristics, the speaker admitted, but he went on to say that coal costs are such that the problem cannot be solved by the simple expedient of buying a better grade of fuel.

The soot blowers are operated every twelve hours, and the boilers are air- or water-lanced every fifth night. "It is obvious," said Mr. Pierson, "that demands for still higher loadings only lead to a vicious circle, making the cleaning problem a matter of direct, or even greater, ratio to capacity demand." He pointed out that the choice in such a situation is to operate at high ratings with low over-all efficiency or with lower ratings with improved efficiency. Lower ratings, however, would reduce station output, and this, of course, is not a desirable solution.

Judging by the attendance at this session, and the discussion which followed the presentation of these three papers, the subject of water walls is at present a very live topic. Among the points brought out in the several written and oral discussions were:

1. Water walls permit greater latitude in selection of fuels.
2. Operating experience has not shown that water walls have prevented slagging with large stokers.
3. Water walls lower the temperature at the edges of the furnace only.
4. Water-wall cooling should be carried well above the fuel line with stokers.
5. Too much is claimed for water walls in reducing furnace maintenance.
6. Water walls should be employed as a means of securing increased capacity with existing installations only.
7. The cost of valves and fittings is often lost sight of in considering the cost of water walls on a square-foot basis.
8. Clinker grinders on large stokers necessitate water cooling on the rear wall.
9. Recent tests with small tubes and forced circulation indicated that the thickness of the metal had little effect, providing the heat was carried away positively. On these tests a heat transfer up to 250,000 B.t.u. per square foot was obtained.

A symposium on domestic heating was held Wednesday evening, these papers being presented: "Economics of House Heating and Insulation," H. B. Johns; "Gas as a Domestic Heating Fuel," M. J. Roberts; "Oil Fuel for Homes," S. D'Arcy Rickard; "A Study

of Electric House Heating," A. R. Stevenson, Jr., and F. H. Faust; "Economic Status of Anthracite and Factors Affecting Its Use as a Domestic Fuel," A. F. Duemler; "Bituminous Coal for Domestic Heating Purposes," F. R. Wadleigh; "Coke as a Domestic Heating Fuel," P. Nicholls, and B. A. Landry.

Smoke abatement was the topic under discussion at both the morning and afternoon sessions on Thursday. The keynote of the discussion of the smoke evil was struck by Harvey N. Davis, whose paper "General Aspects of the Smoke-Prevention Problem," led to considerable discussion.

Human Engineering Necessary

George E. Fisher, chief smoke inspector of Nashville, Tenn., emphasized the human element in the control of smoke in his paper "Mechanical and Human Elements in Smoke Abatement."

"If smoke abatement were only an engineering problem with one visit sufficing to convince the smoke offender that he ought to follow out the proffered recommendations," Mr. Fisher said, "one might go up one street and down another abating smoke with the greatest dispatch, and in most cases with a financial benefit to the individual owner of the stack. However, because of human frailty, prejudice, habit, inertia and distrust, such occurrences are rare, and often many visits have to be made, not to check the accuracy of the original investigations, but patiently to lead the mind of the offender through the gradual evolution of ideas to the acceptance of these first recommendations. The greatest hindrance to smoke abatement does not lie in its economics and engineering, but in the minds and customs of the people."

The present smoke department was organized in Nashville in 1926 and a new ordinance to make enforcement possible was adopted at that time. Mr. Fisher told of some of the experiences and difficulties, both from engineering and human sources, which have confronted the department since that time.

"Smoke abatement is sold on its merits," he stated. "An attempt is made to engender among the people confidence in the work being done and in the recommendations offered. A firm belief is held that smoke abatement does not generally bring oppression; it renders cheap and valuable aid. Money spent on abating smoke is not charity, but a wise investment. A smokeless stack denotes an economical plant and an enterprising owner."

Experiences in the abatement of smoke in Knoxville, Tenn., for many years classified as one of the smokiest cities in the Southeast, were given in a paper by F. L. Wilkinson, Jr., chief engineer of the Bureau of Smoke Regulation, Knoxville. Close proximity to the eastern Kentucky and eastern Tennessee coal fields has made bituminous coal the almost universal fuel for the generation of heat and power. The cheapness of coal has been a decided incentive to an almost universal disregard of efficiency in its use, resulting in a marked fuel waste and a decidedly smoky atmosphere.

Although agitation for smoke abatement in Knoxville began in 1911, a satisfactory ordinance for the solution of the problem did not go into effect until March, 1928, and active work started by the Bureau of Smoke Regulation in May of the same year.

Abatement in Salt Lake City

An observation tower 267 ft. high is used in Salt Lake City to watch for smoke ordinance violations, J. Billeter, chief smoke inspector of the Utah city, pointed out in his paper. From the tower, he said, the smoke department is able to observe the stacks of about 1,300 heating and industrial plants. Many of these are operated smokelessly, so that actual contact and careful supervision from the tower is restricted to about 700 plants at the present time. Telephone service enables the observer to communicate with any plant, and smoke violations are checked up as soon as possible by the inspectors.

"The primary duty of inspectors," said Mr. Billeter, "is the instruction of all firemen in the districts assigned to them, cautioning firemen who show carelessness and inefficiency, and giving any assistance that may be necessary where smoke occurs from breakdowns or other unexpected conditions."

The result of the smoke-abatement campaign in Salt Lake City was a reduction of all dense smoke, from 10,891 min. per week in 1921 to 1,050 min. per week in 1925. The discontinuation of the active smoke abatement work in 1925 led to an increase in smoke emitted, so that the figure was up to 2,482 in 1927. At the present time the figures have been again reduced to slightly over 1,000 min. of smoke per week.

Philip Drinker, assistant professor of ventilation and illumination at Harvard School of Public Health, presented a paper, entitled "Atmospheric Pollution and Sunlight," in which he told the results of a two-year investigation of the effect of atmospheric pollution on visible sunlight and ultra-violet light, as conducted at the Children's Hospital, Boston.

"Neither the results of our laboratory nor those at the Children's Hospital showed that atmospheric pollution from smoke in Boston is a menace to health," Mr. Drinker said.

New Smoke Recorder Uses Photo-Electric Cell

Great interest at the smoke abatement session was centered upon a description of a photo-electric smoke recorder, described by V. P. Griffin and J. V. Breisky, Pittsburgh, Pa. One of the hardest questions in the field of smoke abatement always has been, "How much smoke is going up the chimney now?" When the sky is blue and the wind is gentle, the fireman may gaze up to the top of the stack and form a fairly reliable estimate. Several mechanical devices, periscopes and charts have made this fairly easy. But when there are black clouds in the sky, when the winds come in gusts or during the night, it is difficult, if not absolutely impossible, to judge how much smoke, how many dollars, are departing unused. The new photo-electric smoke recorder appears to solve this problem. The instrument, which may be located in the boiler room or the executive's office, gives an accurate indication and a permanent continuous record, day and night, of the smoke that passes on its way to the atmosphere. It can be made to sound an alarm when the smoke density reaches a predetermined value.

Briefly, the scheme of operation is to project a beam of light through the stack or the breeching onto a photo-electric cell. Depending upon the smaller or greater density of smoke in the stack, the cell receives more or less light, which causes the flow of a smaller or greater amount of current. This current is then amplified to operate standard instruments.

Two weatherproof boxes contain the heart of the apparatus. One contains the light source, a low-wattage incandescent lamp, a lens for collecting the light rays into a parallel beam, which is projected across the stack, and adjustments for focusing the beam. The other contains the cell, the necessary lens for focusing the beam, and amplifying equipment. A flow of air drawn in through a vent in the rear of the unit prevents soot from gathering on the apparatus. Once the instrument is properly calibrated (zero for no smoke and 5 for smoke so thick that no light will pass), the little pen arm down in the boiler room will automatically write the story when the "smoke goes up the chimney just the same."

Discussion

The opinion was expressed that the average citizen, while alert to questions of water supply, milk supply and sewage disposal, exhibits extreme apathy as to the condition of the air he breathes. It is most difficult to distinguish between the contributing factors to a smoky atmosphere, such as smoke emitted from the stacks of power stations, industrial plants and domestic chimneys. The problem needs the leadership of specially trained men backed by public opinion.

Those discussing the smoke abatement papers were in general agreement that it is necessary to make the subject popular.

There was some disagreement as to the permissibility of down-draft boilers, some claiming that they could not be used without smoke on a variable load. On the other hand, these boilers are acceptable to the smoke bureaus of both Nashville and Knoxville if operated by experienced men. In both these cities, however, wider use of the stoker had done much to reduce smoke.

Victor J. Azbe expressed the opinion that talk of smoke abatement should cease and "smoke elimination" be substituted, inasmuch as methods, fuels and equipment are available for smokeless operation.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

*Spot * News*

A SOLAR MOTOR, *claimed to be far more efficient than any yet devised for obtaining mechanical power from the heat of the sun, has just been patented by Prof. Robert E. Goddard, head of the physics department of Clark University.*

* * *

CONSTRUCTION *is under way of a 180,000-hp. hydro-electric plant in the Rhone Valley, near Sion, Switzerland. An artificial lake will be built at an altitude of more than 6,500 ft., from which water will be conducted to the plant after a drop of 5,750 ft. This will be the highest construction of its kind in the world.*

* * *

POWER PRODUCTION *in Italy increased from 3,996,899,000 kw.-hr. in the first half of 1928 to 4,381,597,000 kw.-hr. in the first half of 1929, and imported power increased from 114,223,000 to 120,506,000 kw.-hr., bringing the total power furnished by 270 private and public organizations from 4,111,122,000 to 4,502,103,000 kilowatt-hours.*

* * *

LICENSE TO MANUFACTURE *the single-acting Diesel engine designed by Norman McCarty and described in the March 12, 1929, issue of* Power *has been granted to the Chrysler Corporation, it was announced last week by the General Super Diesel Motors Corporation, holders of the patent.*

* * *

ERECTION *of a 250,000-hp. hydro-electric power plant at Chats Falls on the Ottawa River, Canada, is planned by the Royal Securities Corporation, of Montreal. The project will cost between $3,000,000 and $4,000,000.*

* * *

ACCORDING TO REPORTS *received by the Bureau of Mines, the production of crude petroleum in the United States during August amounted to 92,288,000 bbl., a daily average of 2,977,000 bbl., and a new record. This represents an increase in daily average production over the previous month of 31,000 barrels.*

A.S.M.E. Will Celebrate Fiftieth Anniversary in April, 1930

Program, National and International in Scope, to be Carried Out in New York, Hoboken and Washington—Humanistic Side of Engineering to Be Stressed

ON APRIL 5, 7, 8 and 9, 1930, many of the world's outstanding engineers will meet in New York, Hoboken and Washington to celebrate the fiftieth anniversary of the founding of the American Society of Mechanical Engineers. The exercises will be non-technical in nature and will stress the humanistic side of engineering. They will be preeminently an exchange of greetings between nations through the medium of a series of papers presented by a prominent engineer from each of sixteen countries or geographical divisions of the world. These papers will develop the theme of what engineering has done for each author's country in a national sense and also for the advancement of world culture and civilization. Those engineers will also endeavor to forecast the lines along which engineering may be expected to develop in the future, and to inform the convocation of some of the great engineering problems confronting their respective nations.

The program will be carried out in three parts. At New York on April 5, the delegates will be conducted to the McGraw-Hill Company and will be entertained in the offices of the *American Machinist*. This portion of the program will commemorate the preliminary meeting of organization of the A.S.M.E. held on Feb. 16, 1880.

The second portion of the program will be held at Stevens Institute, Hoboken, N. J., where the organization meeting of the society was held on April 7, 1880. With the idea of depicting the history of the society and of engineering during the past fifty years and the society's future, a pageant will be enacted. This pageant will feature the life history of an individual called "Control," and will utilize the most modern inventions of engineering in tracing this allegorical conception.

The third part of the program, the main sessions, in which each of sixteen of the world's distinguished engineers will present a summary of his paper, will be held in Washington on April 7 and 8. Washington has been selected to accord with the national and international character of the celebration.

Another outstanding function will be the founders' luncheon, also to take place in Washington on April 8. Following the luncheon, a session will be held in the United States Chamber of Commerce Building at which various awards will be formally bestowed. Honorary memberships will be awarded to individuals who have rendered conspicuous service to the society, and the Holley, Melville, Gantt, A.S.M.E., Fiftieth Anniversary, and other newly founded medals of distinction will be conferred.

At the dinner, also on Tuesday, April 8, the president of the A.S.M.E. will present a paper which will be the national report for the United States and will outline the future possibilities of service of the society. At this time also an eminent scientist will review the past contributions of science to engineering, the relation of engineering to science, and the influence of science on the future of engineering. In addition, a prominent American will present, from an international viewpoint, an evaluation of the influence of engineering invention, development, and accomplishments upon the cultural, social, economic, and political progress of mankind, and an outline of the future of engineering in solving the problems of mankind and in promoting international amity.

New Oil Engine Safety Rules Adopted by Germany

New regulations for the prevention of explosions on Diesel-engined ships have been adopted by the Hamburg, Germany, engine and boiler supervising board as a direct result of the accident on the trial trip of the "Kungsholm," which caused the death of five and injury of 20, according to a report published by the United States Navy Department. These regulations include the following provisions:

"As explosive gas mixtures may be formed in the closed-up parts of oil engines, special care must be given to these, particularly the crankcase. It must be assumed that oil gases contained in the crankcase will expand into the engine room if the engine is heated up or if the covers to the crankcase are opened. It is therefore necessary to provide adequate ventilating arrangements by which gases formed in the

crankcase may be led away. These ventilators must end at non-dangerous points and must be fitted with Davy safety wire gauze. The crankcase should be tight against the engine room. It is also necessary to arrange efficient engine room ventilation in order that the engine room personnel may not be exposed to the influence of oil vapors or burnt gases if glands or pistons are not tight. The ventilation must extend to all parts of the engine room, including the lower and covered-in parts, and should be effected by ventilator pipes going through the floor plates.

"As the heating of bearings may also lead to the ignition of inflammable gases in the crankcase, care must be taken in the construction and lubrication of the bearings so that excessive heating is avoided as far as possible. Lubricating oil collecting in the crankcase must be led off by the shortest way in closed piping to the lubricating-oil collecting tank. If the pistons of the engines are cooled by oil, this oil must be led from the expansion joints in closed piping to the collecting tank. Oil dripping from other parts in the engine room must not be led into the crankcase or into the collecting tank for lubricating oil, but to a special waste-oil collecting tank, from which it should go to the separators to be cleaned for reuse.

"The storage and use of light inflammable oils (with an ignition point below 70 deg. F.) in the engine room is not to be permitted. If the use of such an oil cannot be avoided, a special room must be provided for the work. This room must be separated gas-tight from the engine room and be fitted with special ventilation. The electrical installation in such a room must comply with the regulations for electrical installations in rooms exposed to danger of explosions, and good fire-fighting equipment must be provided."

Several New Steam Units to Be Installed

Two duplicate boilers designed for a steam pressure of 1,400 lb., the highest pressure in commercial use in America today, have been purchased by the Milwaukee Electric Railway & Light Company from the Combustion Engineering Corporation. These boilers will be fired by pulverized coal.

Blast-furnace gas will be burned in a completely water-cooled furnace in four units recently purchased from this same corporation by the Bethlehem Steel Company. The four boilers will have a steam-generating capacity of 150,000 lb. per hour each.

Pulverized fuel will be burned at a steam-generating unit recently sold the Sunbury Converting Works, Belvidere, N. J., by the Badenhausen Corporation. This unit will have a normal capacity of 126,000 lb. of steam per hour and a maximum capacity of 135,000 lb. per hour. It will have water-cooled walls, water-cooled hopper bottom, air preheater, and Carl steel-clad setting.

At another plant of the Sunbury Converting Works, at Sunbury, Pa., a second unit, also arranged for pulverized-fuel firing, has been purchased from the Badenhausen Corporation. In this installation, burners enter under the mud drum, so that firing is from the rear.

The Board of Water Commissioners of Detroit, Mich., is planning to install two boilers of 10,000 sq.ft. heating surface at the Springwells water-works station. Two underfeed stoker units for these boilers will also be installed.

Ford to Install World's Largest

THE Ford Motor Company, Detroit, has awarded a contract to Combustion Engineering Corporation, New York, for two complete steam-generating units for the Fordson plant. These units are designed for 1,350 lb. steam pressure. The steam will be superheated to a total temperature of 750 deg. F. Each unit will have a maximum capacity of 700,000 lb. of steam per hour. This is the highest steaming capacity of any boiler ever built for pressures as high as 1,350 pounds.

These boiler units will be fired by pulverized coal, the fuel entering the furnaces tangentially at the corners to give a turbulent mixing action of fuel and air for combustion. The furnaces will be of the all-metal, water-cooled type. Air pre-heaters will be installed.

It is understood that this plant will also contain a turbine unit of 110,000 kw. capacity. Installation is scheduled to begin the early part of 1930.

The Ford Motor Company was the pioneer industrial company in the use of pulverized coal for steam generation. The first installation, made in 1921, at the Fordson plant, has been consistently followed by additional units until today the Ford Motor Company has nearly a half million square feet of boiler heating surface fired by pulverized fuel.

New York Power System Plans Expansion

Addition of 86,000 hp. to the hydro-electric development of the upper Hudson River, 52,000 of which will be secured by enlargement of the noted Spier Falls plant, is planned by the New York Power & Light Corporation, it was announced recently, at the company offices in Albany. With the addition, Spier Falls will became a 100,000-hp. station, the largest in the state next to those at Niagara Falls. The new power will bring the total installations of the Mohawk-Hudson system to more than 550,000 hp., as compared with about 775,000 hp. produced at Niagara Falls.

Still further power expansion in the upper Hudson River district is forecast in recent reports that the Mohawk-Hudson corporation is negotiating with the Union Bag & Paper Company at Hudson Falls, for power rights, which involve proposed construction of a new plant at Fenimore to develop 75,000 hp. The first of these new plants to be placed in operation will be a 34,000-hp. unit situated just below the Conklingville dam on the Sacandaga River.

Present capacity of the Spier Falls station is 48,000 hp., which is exceeded by the 54,000 hp. of the Cohoes Falls station. With the addition it will become the greatest hydro-electric unit in the system, and will alone exceed the capacity of two of the large steam power stations in the Mohawk-Hudson network.

The addition to the Spier Falls plant is to be completed for service in December, 1931, and is expected to cost more than $1,000,000.

India Basin Steam Plant Nears Completion

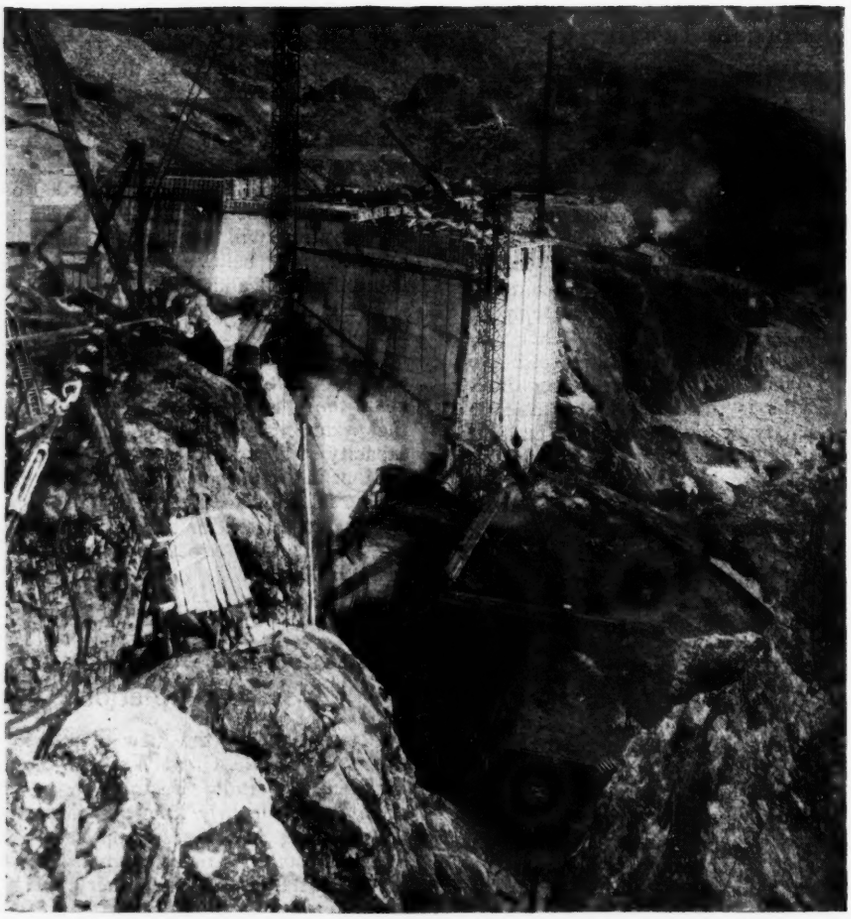
Costruction of the new 35,000-kw. steam plant of the Great Western Power Company on India Basin, San Francisco Bay, is nearly finished. Most of the building has been completed, and the next month is to be spent in finishing the installation of machinery. H. K. Fox, construction engineer in charge of the work, expects the plant to be put into operation during the first part of November.

The plant will be tied in with the Great Western company's system by three distribution lines and three tie lines radiating from India Basin, South San Francisco. This project represents an investment of more than $4,000,000. The India Basin plant will have an ultimate generating capacity of 170,000 kilowatts.

N.E.L.A. 1930 Convention on Pacific Coast

Announcement was made recently from the headquarters of the National Electric Light Association in New York, that the 53rd convention of the association will be held in San Francisco from Monday, June 16, 1930, to Friday, June 20. The convention will be held in the Municipal Auditorium. Consideration is being given to holding an exhibition of electrical machinery, equipment and appliances in connection with the convention. As this will involve the erection of a temporary structure for housing the exhibit, final decision on this point probably will not be made for several weeks.

For many years it has been customary for the association to hold a convention on the Pacific Coast once every five years, having met in San Francisco in 1925, in Pasadena in 1920, and again in San Francisco in 1915 during the World Fair.



CONSTRUCTION work progresses apace on the 90,000-kw. hydro-electric plant of the Seattle municipal light and power system at Diablo Canyon, Wash. This plant, scheduled for completion in April, 1930, is part of the Skagit River development, which, with its ultimate capacity of 1,000,000 hp., is rated as one of the two greatest water power projects in North America.

Los Angeles to Erect New Pumping Plant

The City of Los Angeles, Calif., has made plans for the erection of a new pumping station for transferring water from the reservoir outside the city into the city mains. This new station will be an important factor in the general water system of the city, which is virtually built upon a desert and must depend largely on a supply of water to be obtained from a distance of several hundred miles.

Known as the North Hollywood station, the new pumping plant will be capable of moving approximately 45,000 g.p.m. against a head of 225 ft. The plant consists of four pumping units. Each of the two main units consists of a Worthington two-stage pump, composed of two 24-in. type OX horizontal units in series, being flexibly coupled together and in turn flexibly coupled to the driving motor. The interstage piping will be approximately 30 in. inside diameter. The weight of each pump without its motor is approximately 52,000 lb. The driving motors for these pumps will be Westinghouse 1,200-hp., 80 per cent leading power factor, 6,600-volt, 3-phase, 50-cycle, 8-pole, 750-r.p.m. horizontal, pedestal-bearing types, with direct-connected exciters. Two smaller pumps in this station are to be furnished by the De Laval Steam Turbine Company, one being driven by a Westinghouse 600-hp., 1,000-r.p.m. horizontal synchronous motor, and the other by a Westinghouse 300-hp. horizontal synchronous motor. The four synchronous motors are of fabricated and welded construction and of high efficiency.

Reduced-voltage power for the starting of the four synchronous motors will be obtained from a reduced-voltage bus and a common oil-immersed auto-transformer. The 1,200-hp. and 600-hp. motors are designed for 80 per cent leading power factor, and it is intended that these motors can be disconnected from the pumps and operated as synchronous condensers for power factor correction on the Department of Water & Power system.

The design of this plant was under the supervision of H. A. Van Norman, chief engineer of the Department, assisted by E. F. Scattergood, chief electrical engineer, and F. E. Weymouth, chief hydraulic engineer.

News of Canada

License Requirements of Saskatchewan

By CAMPBELL BRADSHAW
Toronto, Ont.

OF THE 4,574 engineers' certificates so far issued in Saskatchewan, T. Inglis, who heads this branch of the province's Department of Railways, Labor and Industries, as chief inspector of steam boilers, informs *Power*, 117 have been granted for the operation of refrigeration plants only, under the somewhat unique law passed in 1926, which enables applicants to obtain such certificates for motor-driven plants without any steam experience whatever.

There are some 350 high-pressure plants in Saskatchewan, and several thousand low-pressure systems. Certificates of any grade being good for life, the various classes, and number of each issued, are: First class, 181; second class, 776; third class, 909; final traction, 2,591; refrigeration, 117. All questions pertaining to refrigeration have been eliminated from the examinations for steam plant operators. The requirements of the first three grades are as follows:

Any person may present himself for examination for a first-class certificate who, having attained the age of 21 years, is the holder of a second-class certificate and has since its receipt, for a period of twelve months, either operated a steam engine and boiler of not less than 100 hp., or acted as assistant in the operation of a steam engine or battery of boilers of not less than 300 hp.; or satisfies the Minister of Railways, Labor and Industries that he has operated a steam engine and boiler of not less than 100 hp. for a period of five years; or shows that he has served three years in a workshop in the manufacture or repairing of engines or boilers, and has, for a further period of twelve months, either operated an engine and boiler of not less than 100 hp., or acted as assistant in the operation of a steam boiler and engine or battery of boilers of not less than 300 hp. in the aggregate.

A first-class certificate may be issued every candidate who receives 60 per cent of the aggregate marks obtainable on the written examination. Such certificate shall entitle the holder to have charge of boilers of any capacity.

Any person may present himself for examination for a second-class certificate who, having attained the age of twenty-one years, is the holder of a third-class certificate and has since its receipt, for a period of at least twelve months, either operated a stationary steam boiler and engine of not less than 35 hp. or acted as assistant in the operation of a boiler of not less than 100 hp.; or shows that he has operated a stationary boiler and engine of not less than 50 hp. for a period of at least four years; or shows that he has served three years in a workshop in the manu-

facture or repairing of steam engines or boilers and has, for a period of twelve months, either operated a boiler and engine of more than 50 hp. or acted as assistant in the operation of a boiler and engine of not less than 100 hp.

A second-class certificate may be issued candidates who receive 50 per cent of the marks obtainable. Such certificate entitles its holder to have sole charge of a boiler or boilers having a capacity not exceeding 300 hp. in the aggregate or a total capacity of not more than 500 hp. when used for heating purposes only, or to act as assistant in the operation of a boiler or boilers of any capacity under an engineer holding a first-class certificate.

Any person may present himself for examination for a third-class certificate who, having attained the age of eighteen years, holds or has held a traction engineer's certificate, and has since its receipt fired a stationary steam boiler or operated a stationary engine for not less than three months; or shows that he has operated a stationary boiler and engine for a period of not less than twelve months; or shows that he has served two years in a workshop employed in the manufacture or repairing of engines or boilers, and has fired a stationary boiler for a further period of three months.

A third-class certificate may be issued every candidate who receives 50 per cent. of the aggregate marks obtainable. Such certificate entitles the holder to have sole charge of any boiler of not more than 100 hp., or to act as assistant in the operation of a boiler or boilers of a total capacity of not more than 300 hp. under an engineer holding a first- or a second-class certificate, or to have sole charge of a boiler or boilers of a total capacity of not more than 300 hp. when used for heating purposes only.

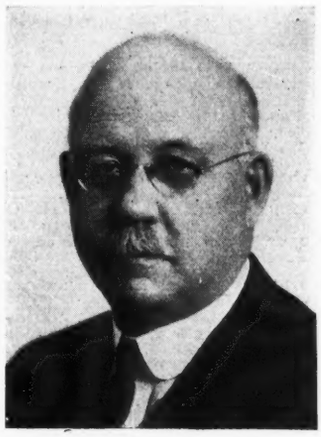
Osage River Project Gets Under Way

The Osage River hydro-electric development in Central Missouri of the Union Electric Light & Power Company, of St. Louis, is rapidly progressing under the supervision of Stone & Webster. At present the office and part of the engineering force is being housed in two club houses which were built by the former holders of the federal permit. The remainder of the staff is at Eldon, some fourteen miles away.

About 1,000 men are engaged in clearing up the underbrush and timber at the dam location and in building roads and buildings. While many of these men are from neighboring farms, the mass of them have come from other localities and are living in tents, wagons and rude shacks. When completed the dam, which will be 150 ft. high, of the gravity type, will convert the Osage River into a lake 50 miles long and, in places, 20 miles wide. While preliminary surveys were made three years ago and the probable shore line staked out, there is no definite data as to the acreage to be flooded.

Prof. Goodenough of Illinois Dies Suddenly

George A. Goodenough, Professor of Thermodynamics at the University of Illinois, chairman of the Western Conference faculty committee on athletics and head of the Big Ten elegibility board, was found dead at his home on Sunday, Sept. 29. Going to the study to summon him to breakfast at 7 a.m. his wife found Professor Goodenough's body slumped in a chair before his desk, where he had seated himself less than



George A. Goodenough

an hour before. During the summer the professor had had a stroke of paralysis, and since that time had been in poor health. The family physician attributed the immediate cause of his death to heart disease. His age was 61 years.

Professor Goodenough was an outstanding leader of scientific thought in the highly technical field of thermodynamics, the basic science of the modern power station. He contributed copiously to the scientific literature in this field through books, bulletins and reports which are widely consulted and regarded as standard references both in this country and abroad. Recognized as a nation-wide authority in his field, Professor Goodenough had been consulting engineer for the General Electric Company in the turbine research department, and in collaboration with Prof. A. C. Willard, head of the department of mechanical engineering, had assisted in the plan for a ventilating system in the Holland Vehicular Tunnel under the Hudson River.

Professor Goodenough was born at Davison, Mich., on May 3, 1868. He was graduated from the Michigan Agricultural College in 1891 with the degree of B. S., and nine years later was awarded the degree of M. E. at the University of Illinois. For the two years following his graduation he remained at the Michigan Agricultural College as a graduate student, teaching part time. During 1893-1895 he was textbook writer for the International Correspondence Schools, at Scranton, Pa., and from 1897-1899 he was editor for those schools. The two intervening years he had spent as instructor at the University of Illinois. In 1899 he returned as assistant professor of mechanical engineering, serving in this capacity until 1905, when he became associate professor of mechanical engineering. From 1911 to date his position at the University of Illinois had been professor of thermodynamics, head of the division.

Professor Goodenough was a member of the society for the Promotion of Engineering Education, the American Society of Mechanical Engineers, Tau Beta Pi, Sigma Xi, Phi Gamma Delta, and the University Club. He was author of several engineering books, among them being "First Course in Calculus" (with E. J. Townsend), 1907; "Essentials of Calculus," 1910; "Principles of Thermodynamics," 1911; a chapter on thermodynamics in the American Civil Engineers' Handbook; a chapter on heat in the Mechanical Engineers' Handbook; "Properties of Steam and Ammonia," 1916; and many engineering experiment station bulletins of which he was either sole author or co-author.

OBITUARY

DAVID LYNDE HUNTINGTON, for the past nineteen years president of the Washington Water Power Company and subsidiary companies, in Spokane, Wash., died Sept. 27, following a lingering illness. While his illness had kept him from his desk for many months, he transacted important company affairs until the time of his death.

Mr. Huntington was a pioneer in the electrical industry. Following his graduation from Yale University with the degree of Ph.B., he entered the employ of the Thomson-Houston Electric Company in 1891. In 1892 he became affiliated with the General Electric Company as assistant engineer at Philadelphia. In 1894 he left that company's employ to become treasurer of the Washington Water Power Company, on Oct. 18 of that year. He became general manager of the company in 1896, vice-president and general manager several years later, and in 1910 he was elected president. He was president of the Spokane United Railways since its organization, July 1, 1922.

Mr. Huntington was a fellow of the American Institute of Electrical Engineers, a member of the Yale Engineering Association, and a member of the National Electric Light Association.

FRANK HENDERSON, manager of the Cleveland office of Combustion Engineering Corporation, New York City, died suddenly Wednesday, Sept. 25, in his fifty-third year. He was born at Tuscola, Ill., Feb. 11, 1876, and joined the Green Engineering Company in 1898. He worked his way up in that organization as service man, tester and

superintendent of service work. In 1922 when the Green Engineering Company was absorbed by Combustion Engineering Corporation, Mr. Henderson, who was then managing the Cleveland office, became the district manager for Combustion Engineering Corporation in which postion he continued until his death.

H. Cole Estep, first vice-president of the Penton Publishing Company, publisher of technical journals, died on Sept. 30 at Cleveland, Ohio, at the age of 43. Mr. Estep was internationally known as an engineer. He was a member of the A.S.M.E. and other engineering groups.

He served as engineering editor on *Iron Trade Review*, and later of *Marine Review*, and was closely identified with the development of *Daily Metal Trade*.

Personals

William Whipple, formerly superintendent of the Cinclare Central Factory, Cinclare, La., has accepted the position of professor of steam engineering on the faculty of Louisiana State University at Baton Rouge.

Edgar A. Rogers, for six years associated with McClellan & Junkersfeld, Inc., in St. Louis, recently became connected with the Philadelphia office of Ford, Bacon & Davis, Inc.

Jacob E. Warnock has left the United States Engineer's office in Huntington, W. Va., where he was engaged on water power investigations, and is now in the hydraulic department of the Aluminum Company of America, Pittsburgh, Pa.

H. C. Thomas has been appointed director of manufacturing stocks for the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. In his new work Mr. Thomas will be responsible for the methods used in the control of all raw materials, work in progress and finished-part stocks.

William E. Wood, Richmond, Va., president of the Virginia Electric & Power Company, has been promoted to the position of vice-president in charge of operations of the Engineers' Public Service Company, holding company for the Stone & Webster interests and managing corporation of many utility companies in America. J. Frank McLaughlin, district manager of the Stone & Webster properties in Texas, Louisiana and New Mexico, has been named president of the Virginia Electric & Power to succeed Mr. Wood.

Charles R. Hunderhill has severed his connection with the Wappler Electric Company, Inc., and will tour the United States combining business and recreation.

Coming Conventions

American Institute of Electrical Engineers. District meeting at Chicago, Ill., Dec. 2-4. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Mechanical Engineers. Annual meeting at New York, N. Y., Dec. 2-6. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

World Engineering Conference. Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

Business Notes

DeLaval Steam Turbine Company, Trenton, N. J., has taken a license to manufacture under the American Bauer-Wach patents. These patents cover the use of exhaust turbines and gears to utilize the exhaust from reciprocating engines.

Trico Fuse Manufacturing Company, Milwaukee, Wis., has moved its office in Chicago to larger quarters, at 549 W. Washington Boulevard, to take care of increased business.

Chain Belt Company, announces that Hibbard S. Greene, who has been appointed assistant to the president of that company, will co-ordinate the marketing plans of the Chain Belt Company, Sivyer Steel Casting Company, Federal Malleable Company, Interstate Drop Forge Company, all of Milwaukee, Wis., and the Stearns Conveyor Company of Cleveland, Ohio. These companies are controlled by the same financial interests. Mr. Greene was formerly vice-president and director of the Barber-Greene Company of Aurora, Ill.

St. Louis Motor Valve Company, St. Louis, Mo., has established a sales office at 246 Fifth Ave., New York City, to facilitate handling its business in the East. Arthur B. Schellenberg is in charge of the office.

Prest-O-Lite Company, Inc., of New York City, has just placed in operation a new acetylene gas plant at 575 Kirkland St., Grand Rapids, Mich. This latest addition to the growing chain of Prest-O-Lite acetylene gas plants is under the superintendency of George Rose, Jr.

Brown Instrument Company, Philadelphia, Pa., has just completed a 60 per cent addition to its factory buildings. This company now employs over five hundred people and does a business well over $3,000,000 annually.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.00 @$2.35
Kanawha	Columbus	1.30 @ 1.60
Smokeless	Cincinnati	2.00 @ 2.25
Smokeless	Chicago	2.25 @ 2.50
S. E. Kentucky	Chicago	1.35 @ 1.60
Steam	Pittsburgh	1.50 @ 1.60
Gas Slack	Pittsburgh	1.00 @ 1.10
Big Seam	Birmingham	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$3.00
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Oct. 10, f. o. b., Bayonne N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Oct. 1, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.59936 per bbl. or 42 gal.; 26@28 deg., $1.64936 per bbl.; 28@30 deg., $1.69936 per bbl.; 30@32 deg., $1.74936 per bbl.; 32@36 deg., gas oil, 4.776c. per gal.; 37@40 deg., distillate, 5.98c.

Pittsburgh—Oct. 8, f. o. b. local refinery, 30@34 deg., fuel oil, 4c. per gal.; 36@40 deg., 4.25c. per gal.

Philadelphia—Oct. 5, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Oct. 1, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—Sept. 21, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70@75c. per bbl.; 26@30 deg., 95c.@$1.00 per bbl.; 30@32 deg., $1.10 per bbl.

Boston—Oct. 7, tank-car lots, f. o. b., 12@14 deg., Baume 4.5c. per gal.; 28@32 deg., 5.5c. per gal.

Dallas—Oct. 5, f. o. b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

Trade Catalogs

Boilers and Auxiliaries—A new edition of the condensed general catalog, GC-5, has recently been published by Combustion Engineering Corporation, New York City. This sixteen-page booklet illustrates and describes in a brief way the more important fuel-burning and steam-generating equipment manufactured by this organization.

Conveyors—Four leaflets describing the Cleveland "Tramrail" overhead-system conveyor have been published by the Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Company, Wickliffe, Ohio. These leaflets describe the various features of this type of tramrail conveyor, and illustrate it in actual service in several plants.

Meters and Recorders—Among the catalogs recently published by Leeds & Northrup Company, Philadelphia, Pa., are the following: Catalog No. 93, entitled "The Homo Method for Production Tempering"; Catalog No. 87, entitled "Potentiometer Pyrometers"; Catalog No. 86, describing optical pyrometers; Catalog No. 870, describing potentiometers for temperature control in oil refining.

Switches—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing its catalog No. 282 on safety switches and motor starting switches. This catalog gives the distinctive features and detailed data on all classes and kinds of Westinghouse safety switches, motor-starting switches, cutouts, line starters, meter service switches, panel boards and wiring devices, including tape, fuses, conduit bushings, and the like. The National electric code regulations on switches and motor protection are also contained in the volume.

Flexible Couplings—Poole Engineering & Machine Company, Baltimore, Md., gives a comprehensive view of the flexible couplings it manufactures in a new handbook entitled "Flexible Couplings, Their Value and Many Advantages." Dimensions and capacities of the various types are included.

Steam Purifiers—The purification of steam to protect superheaters, turbines and other apparatus from water and solids carried with the steam is discussed in Bulletin 684 just issued by the Cochrane Corporation, Philadelphia, Pa. The requirements to be met by steam purifiers and a description of the Cochrane purifier are taken up, followed by tabulated data of numerous tests.

Electric Equipment—Among the bulletins recently put out by the General Electric Company are the following: GEA-1003A and GEA-1004A, "Outdoor Switching Equipment"; GEA-1122, "Insulators"; GEA-226A, "Surface Air Coolers"; GEA-1128, "Steel Panel Switchboards"; GEA-1152, "Synchronous Motors for Pumping"; GEA-1133, GEA-197B and GEA-957A, "Mechanical-Drive Turbines"; GEA-25C, "Line Breaker Equipment"; GEA-1127, "Carrier-Current Telephone."

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ark., Morrilton—City is having preliminary plans prepared for the construction of waterworks and distribution systems, also municipal light plant. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, Mo., are engineers.

Calif., Los Angeles—Crescent Homes Apartment, is having preliminary plans prepared for the construction of a 13 story apartment including steam heating system, electric elevators, etc. at Sunset Blvd. and Havenhurt Dr. Estimated cost $500,000. L. L. Jones, 2054 West 7th St., is architect.

Calif., Los Angeles—Finley Realty Co., 925 South Westmoreland Ave., is having plans prepared for a 7 story apartment building including electric heating system, elevators, etc. at Westmoreland and San Marino Sts. Estimated cost $500,000. Postle & Postle Bank of Commerce Bldg., are architects. Work will be done by owners forces.

Calif., Los Angeles—Los Angeles Stock Exchange, awarded contract for the construction of a 13 story stock exchange building at 618 South Spring St., to P. J. Walker Co., W. M. Garland Bldg. Estimated cost $1,000,000. Steam heating system, electric elevators, etc., will be installed.

Calif., Los Angeles—Screenland Inc., c/o W. Leavers, Music Arts Bldg., Archt., is having plans prepared for the construction of a 4 story hotel at Hollywood Blvd. Estimated cost $2,500,000.

Calif., Los Angeles — Syndicate, c/o H. Chandler, is having preliminary plans prepared for the construction of a hotel at Krotona Hill. Estimated cost $2,000,000. G. B. Kaufmann, Union Bank Bldg., is architect.

Calif., Monterey—Monterey Ice Delivery Co., subsidiary of Union Ice Co., 354 Pine St., San Francisco, had plans prepared for the construction of a 1 story, 75 x 100 ft. ice manufacturing plant here. Estimated cost including equipment $50,000. Private plans.

Calif., San Francisco—California State Board of Harbor Commissioners, Ferry Bldg., is having plans prepared for the construction of a cold storage terminal at Pier No. 48. Estimated cost $250,000. F. G. White, Ferry Bldg., is engineer.

Conn., East Hartford (br. Hartford)—Pratt & Whitney Aircraft Co., F. B. Rentschler, Pres., 450 Capital Ave., Hartford, awarded contract for a 54 x 128 ft. power plant to R. G. Bent Co., Inc., 93 Edwards St., Hartford. Estimated cost $75,000.

Ga., Atlanta—Dinkler Hotels c/o C. Dinkler, Ansley Hotel, plans the construction of a 20 story hotel on Peachtree St. Estimated cost $3,000,000. G. L. Preacher & Co., Wynne-Claughton Bldg., are architects. Thompson, Holmes & Converse, 100 Park Ave., New York, N. Y., are associate architects.

Ga., Milledgeville—Georgia Power Co., P. S. Arkwright, Pres., Atlanta, plans the construction of a hydro-electric development, 60,000 hp. capacity on the Oconee River at Furman Shoals, four miles north of here.

Ill., Maywood—Provise Township High School Dist. No. 209, had plans prepared for the construction of a 2 and 3 story addition to high school including detached power plant, machine shop, manual training shop, etc. on First Ave. Estimated cost $800,000. J. C. Llewellyn & Co., 38 South Dearborn St., are architects. J. A. Chiaro, 503 Main St., is associate architect.

Ind., Evansville—Bd. of Water Works, will receive bids until Oct. 24 for extensions and improvements to waterworks including pumping station. Estimated cost $18,000. Black & Veatch, Mutual Bldg., Kansas City, Mo., are engineers.

Mass., Salem—Salem Electric Light Co. c/o C. H. Tenney Co., 38 Chauncy St., Boston, Engr., is having sketches made for the construction of a power plant on Water St. located at Old Philadelphia & Reading Coal Wharf on water front. Estimated cost $18,000,000.

Mass., Somerville (Boston P. O.)—Rubel Coal & Ice Corp., 937 Fulton St., Brooklyn, N. Y., had plans prepared for the construction of a 1 story, 85 x 95 ft. ice manufacturing plant at Beachery Court here. Estimated cost $100,000. A. W. K. Billings Jr. Inc., Little Bldg., Boston, is architect.

Mass., West Springfield (br. Springfield)—Town, awarded contract for the construction of a pumping station at Bear Hole Reservoir to L. S. Wood, 14 Stockbridge St., Springfield. Estimated cost $40,000.

Mich., Ann Arbor — State Administrative Board, Lansing, plans the construction of a group of hospital buildings, including heating plant, etc. Estimated cost $7,500,000. A. Kahn, 1000 Marquette Bldg., Detroit, is architect.

Mich., Ann Arbor—University of Michigan, awarded contract for a 5 story law library on Monroe St. to James Baird Co., 101 Park Ave., New York, N. Y. Estimated cost $1,500,000. Steam heating system, elevators, etc. will be installed.

Mich., Detroit—Union Trust Co., Union Trust Bldg., is having plans prepared for the construction of a stock exchange building including steam heating and ventilation systems, boilers, elevators, etc. on Griswold St. Estimated cost $500,000. C. Kotting, 2306 Dime Bank Bldg., is architect.

Mich., Eloise—Wayne County, Bd. of Supervisors, County Bldg., H. H. Prenzlaver, Secy. Bd. of Superintendents of Poor, will receive bids until Oct. 15 for the construction of a 5 story hospital including steam heating system, boilers, elevators, etc. on Michigan Ave. Estimated cost $750,000. Maul & Lentz, David Whitney Bldg., Detroit, are architects.

Mich., Harbor Beach—City plans the construction of a waterworks system including pump house, filter tanks, etc. Estimated cost $30,000. Work will be done by day labor.

Mich., Lansing—R. E. Olds Co., Capital Bank Bldg., will soon award contract for the construction of a 25 story, bank and office building on Allegan St. including steam heating system, elevators, etc. on Allegan St. Estimated cost $1,500,000. Hopkins & Dentz, 415 Lexington Ave., New York, N. Y. architects.

Mich., Pontiac—Pontiac General Hospital, awarded contract for the construction of a 5 story hospital including power house, etc. on Johnson St. to Devault & Dietrick, Canton, O. Estimated cost $333,835.

Mich., Saginaw—Consumers Power Co., Jackson, awarded contract for the construction of a coal dock to include coal conveyor and equipment on Saginaw River to Stevens & Wood, Consumers Power Bldg., Jackson. Estimated cost $700,000.

Minn., St. Paul—M. T. Baker Co., 330 Baker Bldg., Minneapolis, plans the construction of an office building at Wabasha, Fourth Cedar and 5th Sts. Estimated cost $2,000,000. Larsen & McLaren, 308 Baker Bldg., Minneapolis, are architects.

Miss., Meridian—Mississippi Building Comn., awarded contracts for the construction of a service building to Garber & Lewis, Jackson, also power plant at East Mississippi State Hospital here, to Alonzo B. Hayden, Pass Christian. $173,855.

Mo., St. Louis—J. Rubin, 18 North 8th St., will build a 12 story apartment building including steam heating system, two electric elevators, etc. at West Pine Blvd. and Euclid Ave. Estimated cost $800,000. P. J. Bradshaw, 718 Locust St. Work will be done by separate contracts.

N. J., Asbury Park—Owner, c/o Morris & Erskine, 1716 Cherry St., Philadelphia, Pa., Archts., are receiving bids for the construction of a 4 story memorial hospital including steam heating and refrigeration systems, boilers, elevators, etc. Estimated cost $1,000,000.

N. J., Hillsdale—Dept. of Institutions & Agencies, State Office Bldg., Trenton, will receive bids until Oct. 16 for the construction of a power house at Hillsdale Hospital here. Estimated cost $50,000. Guilbert & Betelle, 20 Branford Pl., Newark, are architects.

N. J., Newark—Steuben Club of Newark, 43 Central Ave., is having revised plans prepared for an 8 story theatre, club and stores including steam heating and ventilation systems, boilers, elevators, etc. at Washington and Linden Sts. Estimated cost $1,000,000. F. H. Koenigsberger, 48 Walnut St., is architect.

N. Y., Rochester—Dept. of Mental Hygiene, Capitol, Albany, N. Y., will receive bids until Oct. 16, for the construction of a new power house at Rochester State Hospital here.

N. Y., New York—Broadway Central Securities Corp., G. M. Dickerson, Pres., 1658 Broadway, plans the construction of a sports arena including ice skating rink, swimming pool, at 146th St. between Lenox and 7th Aves.

N. Y., New York—Werner Nygren, 101 Park Ave., Engrs., will soon receive bids for the construction of a 9 story psychopathic hospital, including steam heating and ventilation systems, etc., at 29th and 30th Sts., and First Ave., for Dept. of Hospitals, Municipal Bldg. Estimated cost $3,000,000. Thompson Holmes & Converse, 101 Park Ave., are architects. A. H. Belcom, 10 East 47th St., is structural engineer.

N. D., Grafton—City awarded contract for the construction of a new municipal electric power plant, to B. D. Johnson, Grafton. Estimated total cost $70,000. Equipment contracts let.

O., Akron—Central Savings & Trust Co., 12 East Mill St., awarded contract for a 24 story bank and office building at Main and Mills Sts. to Carmichael Construction Co., Central Saving & Trust Bldg. Estimated cost $2,000,000.

O., Cincinnati—Schwartz Realty Co., Provident Bank, plans the construction of a 10 story apartment on Reading Rd. Estimated cost $1,000,000. O. Schwartz, Provident Bank, is architect.

O., Cleveland—Hupp Motor Car Corp., East 131st and St. Clair Ave., awarded contract for a 1 story addition to boiler house at East 131st St. and St. Clair Ave. to S. W. Emerson Co., 1836 Euclid Ave. Estimated cost $40,000.

Okla., Farview—City voted $30,000 bonds for extensions and improvements to electric and power system.

Pa., East Pittsburgh—Westinghouse Electric & Mfg. Co., awarded contract for the construction of a 34 x 63 ft. power house, 60 x 90 ft. service building and research building, on Ardmore Blvd., to Mellon Stuart Co., Oliver Bldg., Pittsburgh.

Pa., Erie—City is having preliminary plans prepared for waterworks improvements including filtration plant, pumping plant and equipment. Estimated cost $700,000.

Pa., Frazer — Bd. of Supervisors, Frazer Township, awarded contract for the construction of sewage system and sewage pumping station to G. J. Coffey & Co. Estimated cost $28,000.

Pa., Philadelphia—Mechanics Insurance Co. of Philadelphia, 8 Park Pl., Newark, N. J., is having sketches made for the construction of an office building including steam heating system at Walnut and 5th Sts. Estimated cost $500,000. J. H. and W. C. Ely, 605 Broad St., Newark, N. J., are architects.

Pa., Pittsburgh—Manufacturer Light & Heat Co., Columbia Bank Bldg., awarded contract for the construction of a 1 story, 36 x 155 ft. compressor station at Neville Island to Nicola Building Co., 127 North Highland St. Estimated cost $40,000.

Texas—Point Isabel Co., c/o C. R. Tyrrell, plans electrification of line between Point Isabel and Brownsville. Owner recently purchases this line from Rio Grande Ry. Co. also plans electric tram line between San Benito and Point Isabel. $75,000. Private plans.

Tex., Austin — State Bd. of Control, c/o R. B. Walthall, Chn., will receive bids until Oct. 16, for the construction of a group of buildings including 2 story, 34 x 78 ft. dormitory, 1 story 32 x 68 ft. ice plant, etc. at Austin State School. Estimated cost $100,000. H. F. Kuehne, 824 Littlefield Bldg., is architect.

Tex., Big Spring—City, c/o C. W. Cunningham, Mayor, plans an election Nov. 12 to vote $500,000 bonds for municipal improvements, including central fire station, two sub-stations, city hall, sewage disposal plant and water system improvements.

Tex., San Antonio—Emmy Dittmar Improvement Co., 599 Howard St., is having plans prepared for the construction of a 22 story apartment hotel. Estimated cost $2,000,000. Richard Vander Straten, Travis Bldg., is architect. Herff & Jones, c/o San Antonio Loan & Trust Co., are associate architects.

Tex., San Perlita—San Perlita Development Co., plans the construction of an ice and cold storage plant. Estimated cost $25,000. Private plans.

Wash., Seattle—Mark Twain Investment Co., c/o E. Morrison, Lloyd Bldg., awarded contract for the construction of a 20 story apartment building at 7th Ave. and Seneca Sts. to P. Ford, Lyon Bldg. Estimated cost $1,000,000.

Wash., Seattle — United Mortgage Security Co., Republic Bldg., will soon receive bids for the construction of an 18 story apartment building at 9th and University Sts. Estimated cost $1,500,000. L. Baeder, Republic Bldg., is architect.

Wis., Milwaukee—O. Bachman, 520 Wisson St., is having plans prepared for the construction of a 22 story office and stores building at 6th St. and Wisconsin Ave. Estimated cost $1,000,000. Weary & Alford, 1923 Calumet Ave., are architects.

Wis., Milwaukee—Wells Investment Co., W. J. Sadres, Pres., 2801 Lisbon Ave., plans the construction of an 8 story hotel including steam heating and refrigeration systems, elevators, etc. at 13th and Wells Sts. Estimated cost $650,000. J. Topzant, 144 East Wells St., is architect.

B. C., Prince Rupert—Canadian Fish & Cold Storage Co., plans the construction of a cold storage plant at Waterfront.

B. C., Vancouver — Royal Bank, 400 West Hastings St., will soon award contract for the construction of a 17 story office building at Hastings and Granville Sts. Estimated cost $1,500,000. G. S. G. Davenport, 30 Forden Court, Montreal, Que., is architect.

Ontario—Municipalities of East Windsor and Walkerville, plan the construction of a joint waterworks pumping plant. Estimated cost $100,000. J. C. Keigh, Essex Border Utilities Commission, Windsor, is engineer.

Ont., Oshawa—G. W. Hezzellword, c/o General Motors Ltd, plans the construction of an ice arena on King St. Estimated cost $125,000.

Que., Chat Falls—Royal Securities Corp., 164 St. James St., Montreal, plans the construction of a hydro-electric development, 250,000 hp. capacity on the Ottawa River, 35 mi. above Ottawa. Contract awarded for a 30 ft. dam on the Quebec side of the River to Morrow & Beatley, Peterboro, Ont. $2,000,000. Total estimated cost $3,000,000 to $4,000,000.

Equipment Wanted

Compressors—Bureau of Yards & Docks, Navy Dpt., Washington, D. C., will receive bids until Oct. 30 for furnishing and installing a 6-ton ammonia compressor, condenser modification compressor foundation, etc., at Mare Island, Calif.

Engine and Generator—E. R. Brown Co., 28 Lancaster St., Boston, Mass., is in the market for a 50 to 60 hp. Diesel engine and 35 kw. 60 cycle generator.

Engines, etc.—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Oct. 29 for two unaflow steam engines direct connected to electric generator and power plant equipment at Naval Ammonia Depot, Iona Island, N. Y.

Engines and Pumps—Cameron County Water-Improvement Dist. 8, c/o G. P. Barreda, Pres., Brownsville, Tex., will receive bids until Oct. 19, for engines and pumps for proposed irrigation and drainage project.

Fans, Blowers and Control Equipment — Detroit & Canada Tunnel Co., Majestic Bldg., Detroit, Mich., is receiving bids for exhaust fans, blowers and control equipment for proposed ventilation building for vehicular tunnel under Detroit River.

Fuel Oil Burning Equipment—U. S. Veteran's Bureau, Arlington Bldg., Washington, D. C., will receive bids until Oct. 22, for furnishing and installing complete oil burning equipment at U. S. Veteran's Hospital.

Pumps and Motors — Merced Irrigation District, H. P. Sargent, Secy., Merced, Calif., will receive bids until Oct. 22, for furnishing and installing eight drainage pumps and motors complete for proposed irrigation work.

Transformers—Bd. of Purchases, H. C. Cain, Secy., City Hall, Columbus, O., is in the market for two 50 kva. single ph., 2,300-230/115 v. and two 100 kva. single ph. 2,300-230/115 v. pole type distributing transformers; two 100 kva. single ph. pole type transformers, 2,300-230/115 v., 80.6% full capacity in 230 v. winding.

Transformers, etc.—Port and Telephone Dept., Wellington, N. Z., will receive bids until Nov. 6 for 600 copper earthplates; until Nov. 19 for 100 telephone transformers and until Nov. 18 for six resistance spools, 100 ohm, 24 resistance spools 120/120 ohms; 24 resistance spools 150 ohm and 24 140 ohm.

Turbines — G. L. Holland, P. O. Box 1060, Louisville, Ky., is in the market for 100 to 5,000 hp. hydraulic turbines.

Industrial Projects

Calif., El Monte — Fokker Aircraft Co., awarded contract for the construction of a group of buildings for airplane factory on Valley Blvd. to Eaves Construction Co., 1524 La-Baig St. Estimated cost $350,000.

Calif., Long Beach—Shell Development Co., is having preliminary plans prepared for the construction of first unit of nitrogen filtration plant. Initial cost $250,000. Ultimate total cost $5,000,000.

Calif., Los Angeles—Willard Storage Battery Co., 601 South Hope St., awarded contract for the construction of a storage battery plant including administration, factory and power plant to H. M. Baruch Corp., Lincoln Bldg., Los Angeles. Estimated cost $350,000.

Conn., Hartford—Superior Spring & Mfg. Co., 373 Washington St., is having plans prepared for the construction of a factory on Washington St. Estimated cost $65,000. G. L. Dunkelberger, 721 Main St., is architect.

Conn., Stamford—Norma Hoffman Bearings Co., Hamilton St., is receiving bids for the construction of a 1 and 2 story, 100 x 200 ft., factory on Hamilton St. Estimated cost $125,000. Fletcher-Thompson Inc., 542 Fairfield Ave., Bridgeport, is architect.

Ind., South Bend — Bendix Aviation Co. awarded contract for the construction of a 360 x 1,000 airplane factory on Westmore St. to H. G. Christman Co. Estimated cost $400,000. Private plans.

Mass., Abington — Anglo-American Textile Machinery Co., is having plans prepared for the construction of two additional units to plant, 40 x 100 ft. each on Centre Ave.

Mich., Detroit—Koestlin Tool & Die Co., 3601 Humboldt Ave., awarded contract for a 1 and 2 story, 65 x 120 ft. factory and office to Krieghoff Co., 6601 French Rd. Estimated cost $55,000.

Mich., Lansing—Fisher Body Corp., General Motors Bldg., Detroit, awarded contract for a 1 and 2 story, 140 x 250 ft. and 70 x 450 ft. body factory on Division St. to J. A. Utley Construction Co., 739 Penobscot Bldg., Detroit. Estimated cost $250,000. General equipment for auto body finishing will be installed.

Mich., Pontiac — Thompson Aeronautical Corp., Union Trust Bldg., Cleveland, O., awarded contract for the construction of airport buildings including 120 x 129 ft. hanger, 40 x 120 ft. office and shop, 20 x 36 ft. boiler house, 14 x 24 ft. engine testing house here to C. O. Barton Co., 1900 East Jefferson St., Detroit, Mich. Estimated cost $350,000.

O., Akron—Firestone Tire & Rubber Co., H. Firestone, Pres., South Main St., awarded contract for a 7 story, 110 x 180 ft. addition to factory to C. W. & P. Construction Co., 718 Second National Bldg. Estimated cost $500,000.

Okla., Muskogee—DeCamp Glass Casket Co., is having preliminary plans prepared for the construction of a 3 story, 75 x 150 ft. factory. Estimated cost $60,000. Architect not selected.

Ore., Portland—Frostkist Ice Cream Co., 271 East Water St., will receive bids about Nov. 1 for the construction of a 2 story, 100 x 160 ft. ice cream plant etc. at 11th, Taylor and St. Belmont Sts. Estimated cost $50,000. Boilers, pumps, refrigeration equipment, etc. will be required.

Pa., Erie—General Electric Co., River Rd., Schenectady, N. Y., awarded contract for the construction of a 1 story alloy foundry on East Lake Rd., to E. E. Austin & Sons, 1919 Reed St.

Pa., Philadelphia—S. & S. Hosiery Co., c/o H. H. Kline, 709 Chestnut St., awarded contract for a 1 story, 100 x 100 ft. addition to hosiery mill at Keystone and Banner Sts. to W. F. Lotz, Frankford and Oxford Aves. Estimated cost $75,000.

Pa., Tarentum—Tarentum Steel Corp., G. Robinson, Pres., 1716 First National Bank Bldg., Pittsburgh, plans the construction of a steel mill here. Estimated cost $3,000,000.

B. C., Burnaby—Dominion Bridge Co., 275 First Ave. W., Vancouver, awarded contract for the construction of a 1 story, 210 x 600 ft. steel plant including power house, etc. to E. J. Ryan Contracting Co., 445 Granville St., Vancouver. Estimated cost $1,000,000.

Ont., Oshawa—General Motors Co. of Canada Ltd., 210 Spadina St., Toronto, plans a 3 story addition to present parts and service building here.

Ont., St. Catherines—Thompson Products Co., C. E. Thompson, Pres., 2196 Clarkwood Rd. Cleveland, O., manufacturers of automobile accessories, plans the construction of a 1 story manufacturing plant here. Estimated cost $150,000. Roberts-Wright Co., Swetland Bldg., Cleveland, O., is architect.

Ont., Sarnia — Electric Auto Lite Co., Champlain and Mulberry Sts., Toledo, O., is having plans prepared for the construction of a factory on North Sarnia St. here. Estimated cost $150,000. Private plans. Machinery and equipment will be required.

Ont., Walkerville—Motor Products Corp., E. H. Cain, Mgr., Walker Rd., awarded contract for the construction of a 1 story, 150 x 200 ft. addition to factory to Allan & Earl, Equity Bldg., Windsor. Machinery and equipment for the manufacture of motor specialties will be required.